THE

ELECTRICAL REVIEW.

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TECHNICAL EDUCATION OF ARTISANS

SPEAKING at Liverpool the other day on Technical Education, Mr. Preece, in discussing the question generally, and pointing out where the Germans had profited by their scientific education, made one statement to which we think a good deal of weight ought to be attached. He said that technical education was more wanted in the ranks of employers than in the employed. He had never found a lack of enthusiasm in the lower ranks. This we believe to be a statement of fact. There is not a lack of enthusiasm in the ranks of the workers. Get any body of workers together and listen to their conversation, and nine times out of ten it is certain to drift into work. If the men are locomotive drivers, then all their talk is of firing, of coal consumption, of priming, or other points of practice. Take a public house full of engine fitters and erectors in the manufacturing districts, and what will be heard beyond discussions on indicator cards, or on boilers and coal economy? Mr. Preece is by no means a pessimist when he speaks of our future. We are so naturally a people who grumble, that we forget, when we grumble at our own shortcomings, that foreigners may take us at our own valuation. We don't find the Americans practising any self-depreciation. Their products are always of the best, and there is nothing more disappointing than to get hold of some well-cried American product and expect it to be equal to its description. Often the article falls miserably short of the letterpress and block work. It is no doubt in the higher branches that sound education is best calculated to effect results. Unfortunately in our large establishments wealth has too frequently spoiled the employer for scientific work, and destroyed his capacity for appreciating scientific or technical knowledge below him, and he offers bricklayers' wages to his chief assistants. One of the largest chemical works in this country is simply throwing away a fortune for want of an engineer who knows better. One is constantly meeting with examples of wasteful working in various directions, and, generally speaking, one finds the heads of large undertakings absolutely incapable of grasping even the most ordinary questions. The present habit of looking upon Germans as especially sound in their knowledge received lately a severe check in one instance, for a German firm of supposed scientific ability were so blind to the most ordinary technical sense as to allow their cupidity to force them to employ an individual on the "no result no pay" system. The result was failure and loss of money, for somehow they had to pay, though they had no results. It is all very well to learn from the Germans; but we fear we learn too well in some directions and German methods of morality in trade dealings are at times so distinctly questionable, that any attempt at competition will do English reputations no good. We don't want technical education to enable us to defeat the object of tests. Yet this is one of the goals to which some German chemists aspire.

We quite agree with Mr. Preece that the German bogey is being a little overdone, and that we are in danger of going to foolish and wasteful extremes. We think that the facilities being present, the men suited for technical education will be very apt to teach themselves. In the Post Office something on these lines is attempted, and facilities are given, for any who choose to avail themselves of them.

GAS TRACTION IN SHEFFIELD.

Sir F. Mappin has been holding forth on gas traction in Sheffield, but Mr. Hill Hartland, who lives in Grimesthorpe Road, Sheffield—what a fit name for the place—cannot agree with him, and points out that for a "problematical" difference in mileage costs, Sheffield, at the end of 25 years, will be where she stands now, whereas by adopting electricity there would be an increasing revenue in traction, light, and power. In the first place Mr. Hartland points out in his letter to the *Engineer*, that Sheffield is bad enough already without having gas engines exhausting in its streets. He argues that as Sheffield is spending £16,000 on a refuse destructor plant which will not reduce the cost of its refuse disposal, he would have electric traction and he would turn the gases from the power boilers at a temperature of 1,200° to 1,500° into the destructor cells, and work these at 2,000° rather than as now with the aid of a steam blown draught. Mr. Hartland's letter is by no means clear. He appears to ask that the destructor cells should be made more efficient by helping them out with boiler gases at 1,200° to 1,500°, but it may be asked: how many boilers does Mr. Hartland mean to employ? A temperature of rejection of the gases of even 1,200° is very excessive, and we see no proposal to utilise the final gases in any way. We are quite in accord with Mr. Hartland as to the superiority of electric traction for Sheffield, and think that something might be done to combine the destructors and the electric plant, but we want plainer figures and clearer statements than he has given in his letter. Sheffield spends £19,000 a year on its street lighting—a sum sufficient to pay 4 per cent. interest and 5 per cent. depreciation on electric plant of £100,000, and leave £10,000 per annum towards the joint working expenses of traction, light, and refuse treatment, whereby the city would own its works in 25 years with no increase of present cost of street lighting and refuse dealing alone.

Mr. Hill Hartland is perhaps not the best advocate one could find of the advantages of electric traction, but we can hardly help saying: why is any advocate needed to-day? Electric traction is a proved success and only needs to be undertaken. Gas traction has its proper place no doubt, but we hardly think that Sheffield comes into the category of proper or suitable places, whereas it is a very proper place for electric traction on account of its numerous grades.

The Insurance of Central Stations.

The agitation which possesses the central station engineer will, we fear, be little allayed by the statement of the case from a Fire Office point of view, which appears in another part of this issue. It is difficult to appreciate the argument of the fire offices that it is impracticable to deal with stations upon their merits. According to the elaborate system of the insurance companies, all electricity works, no matter whether they be new or old, must be treated alike. One can quite understand that two or three fires will sweep away the premiums of several years, but the fact that two old works were reduced to ashes is no criterion of what might happen to the rest, especially when it is remembered that no other works in the country reproduce the conditions existing in those ill-fated central stations. If these two works were insured at similar rates to those of modern central stations, then we are afraid the elaborate system of classification wants amending. The fact that the underwriter plunged and took stations freely at 2s. 6d. showed no appreciation of the wide difference in design and method of construction. It was always well known to electrical engineers that there were dangerous works in this country, yet the fire offices did not hesitate to take them at low rates. Then when fires occur, the underwriter seeks to minimise his error by imposing heavy fees not only on the dangerous stations but on the safe ones; and the fire offices do not deny the existence of safe works, for our correspondent knows many stations that are admirably designed, well looked after, and in which it is difficult to conceive how any serious fire can happen. The illogical attitude taken up by the insurance companies will, we trust, be modified; indeed, we believe there are distinct signs of the offices showing some abatement in the demand for excessive rates.

The Mutual Insurance of Central Stations.

Although the suggestion of mutual assurance among central stations has been thrown out in these columns, we must confess that after careful consideration we do not think any scheme of mutual insurance will help the central station engineer. The difficulties in the way of such a scheme are innumerable. If adopted it would call for a system of lumping which we object to in the case of the Fire Offices, for it would need an inspection of central stations by the engineers of rival establishments. No matter what course were adopted it would be impossible to exclude dangerous stations, with the consequence that a fire might occur which would land the various works in a considerable loss. The only safe course is to endeavour to prevail on the fire offices to exercise some discrimination in the arrangement of premiums. If they will not adopt the policy of adjustment then no doubt some of the fire-proof works will refuse to insure at all, and that would be infinitely safer than dabbling in mutual insurance.

Thermo-Elements.—Some interesting experiments have recently been conducted by A. Hagenbach, in the *Annalen der Physik und Chemie*, on the subject of thermo-elements composed of amalgams and electrolytes. He determined the thermo-electromotive force for elements, consisting of the following chain:—Cadmium amalgam | solution of a cadmium salt | cadmium amalgam, and of a similar chain for lead. The sulphate, nitrate, chloride, bromide, and iodide of cadmium, and the nitrate and chloride of lead were employed at various concentrations. One electrode was maintained at a temperature of about 6°, and readings taken with the second electrode at temperatures ranging from 6° to 80°. The thermo-electromotive force was found to be approximately proportional to the temperature, except for lead chloride, where it remained almost constant from 30° to 50°, whilst, contrary to expectation, the E.M.F. decreases with increasing dilution, the decrease varying with the different salts. The original paper may be found in the *Annalen der Physik und Chemie*, 1896 (2), No. 58, p. 21 to 36.

CARDIFF EXHIBITION ELECTRIC LIGHTING.

The system adopted is the high tension one, and the machinery is capable of running 200 arc lamps and nearly 2,000 glow lamps. The engines are of the compound type, by Robey, and work at 140 lbs. pressure of steam. There are four in all. The largest is a horizontal engine developing 200 brake H.P., connected to the main counter-shafting by special ropes. At the side of same is a 150 brake H.P. vertical engine driving on to the counter-shafting with leather belting. The two other engines are each of 65 brake H.P., driving a separate counter-shafting by means of leather belts. The second counter-shafting is connected by a friction clutch, so that these two engines can work together or independently.

The generating machines consist of four Brush-Victoria arc lighting dynamos, and an alternator with exciter for incandescent lighting driven off the main counter-shafting, and two alternators with another exciter driven off the small countershafting.

The quaint lanterns which light old Cardiff are specimens of Messrs. Strode & Co.'s mediæval art metal work, and the handsome fittings which they have supplied for the Ladies' Club and Shakespeare House are also of their design and manufacture.

We were much pleased a few weeks ago, when paying a flying visit to Cardiff, to notice the very effective arc lighting of the Exhibition and grounds. The night was wretched in the extreme, the rain having been continuous from early morning, but the arcs gave such a cheery aspect to the place that one could almost forgive the clerk of the weather, and we congratulate Messrs. Strode & Co. on the result.

RAILWAY POWER STATIONS.*

By THOMAS HENNING.

At no time since the advent of the now ubiquitous trolley has there been more energy, ingenuity and enterprise expended upon its improvement than at present.

Cardiff Exhibition Lighting.—View of Electrical Machinery.

The arc lighting machines generate current at a pressure of 2,700 volts, and each supply 55 lamps. The alternators supply current at 2,200 volts transformed down to 100 volts at various transformer stations.

The main switchboard was specially designed by Messrs. Strode & Co. for this installation. It is about 12 feet long and 14 feet high, with a raised platform for the engineer, to enable him to have all the switches and instruments well within his control. The switches are so arranged that any machine can be put on to any circuit, and synchronisers are provided to enable any two alternators to be run together on one circuit.

The wiring is all carried out on the two-wire system, the main cable from the alternators to the transformers being concentric. The cables and wires have been so arranged that the circuits are interlaced, and if any machine should break down, no part of the building will ever be in total darkness.

Of course, the commercial view is the all-important one to business men, notwithstanding which, when one follows the peregrinations of the various factors which, combined, turn the wheels of a trolley car, and observe the thousand and one loop-holes by which energy is allowed to escape without performing useful work, one would imagine for a moment that one or two roads had been constructed and maintained for amusement.

Permit me to call your attention to a few of the errors made in years gone by.

The first question of vital importance presenting itself will be the site. Should an experienced man be called upon to choose a site, it would cost a few dollars. For this reason inexperienced persons have at times done the work and chosen the site, for the reason that it was in the vicinity of

* Paper read before the New York Street Railway Convention.—New York *Electrical World*.

the work to be performed, regardless of the questions pertaining to fuel and water, or they may have chosen it owing to the contiguity of one factor, and disregarding the remaining factors. This is a more expensive method than paying for having the matter properly attended to.

In the construction of a plant heavy losses are frequently borne, owing to misplaced material, which being lost sight of, necessitate duplicate requisitions, &c. A clerical force sufficiently large to keep an accurate account of all material required, ordered, received and used, will pay a handsome profit on the outlay.

In operation, we are again confronted with many wasteful outlets. The pumps may be kept in service without examination until convenience or absolute necessity compels action; the boilers, with scale on one side of the tube, and soot on the other; the steam pipe covering defective; the engines in service without overhauling, until they quietly refuse to do further duty; the dynamo commutators, rough, or brushes not properly fitted to them; switches and leads of insufficient capacity, switches unclean, their faces rough, and lug joints not properly made; the feeders inadequate for the work required of them; motor commutators and brushes neglected, and finally the rails not properly bonded, if bonded at all.

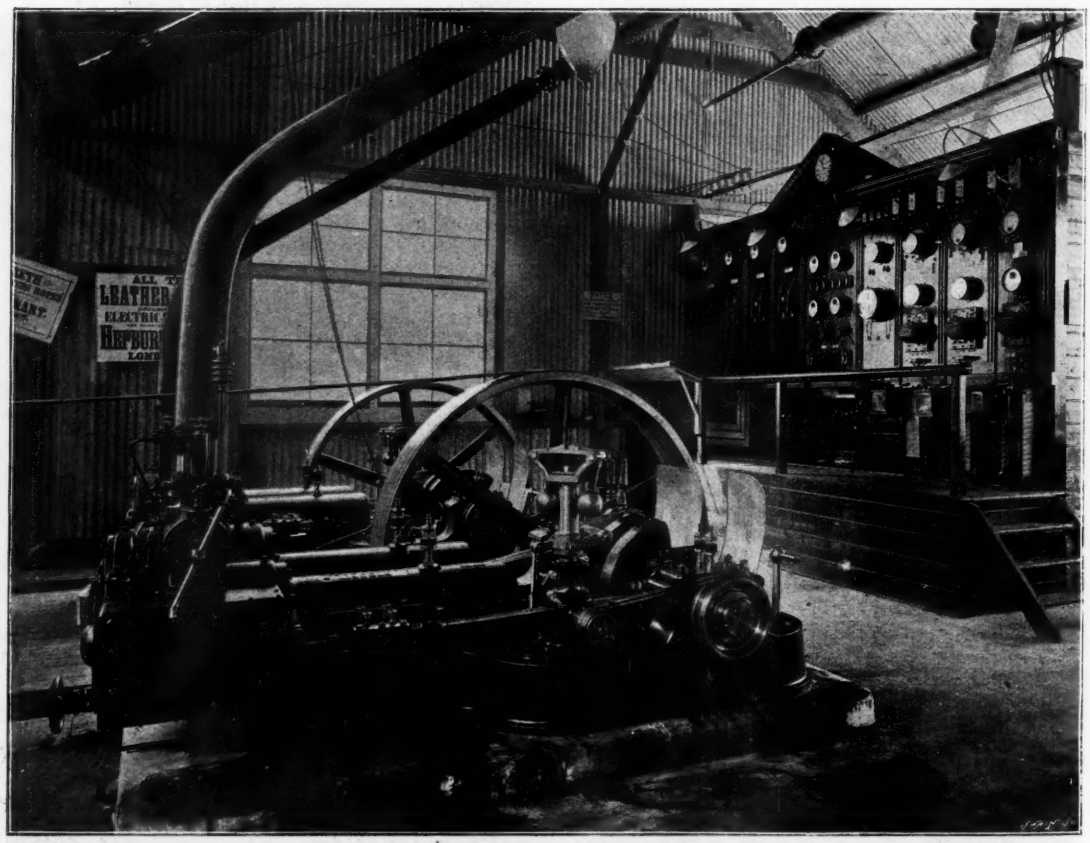
I have known of instances of units having been kept in service under full loads and overloads (notwithstanding the fact that there were units idle) upon the theory that the larger the output from each unit the greater the economy. I believe that this is a delusion, and should be avoided. It is not economical to overload any part of the plant unless absolutely necessary.

All these weak spots waste money every minute that the system is in operation. It may be that each person concerned is so absorbed in devising new and novel means for the propulsion of cars, and for other purposes, that we forget for a time to make the best of our present opportunities. When a weak spot is observable in any part of the system, repairs should be begun at the earliest possible moment. If allowed to run along until necessity compels them, it will prove to be a very expensive and a very dangerous practice.

In stations of 2,000 horse-power or over, it will pay to extract the oil from the wipers, which may be done by enclosing them in a tank into which a steam jet has been inserted; the oil upon rising to the top of the tank may be drawn off for purification, the wipers dried out and used again, repeating the operation until the wipers are worn out.

There is nothing connected with a power station that will pay a larger dividend than cleanliness. If the station be kept scrupulously clean, the employés will take more interest in their work, and the treasurer will not be called upon to pay for so many tools and other things lost and misplaced.

Of course, as science and capital are moving along rapidly hand in hand, we may reasonably expect in the near future to be able to eliminate some of these factors which tend to swell the cost of power. The success of long-distance transmission, and the improvements quietly but continually being made in motors, dynamos, and other electrical appliances, indicate that the time is approaching when we may expect a higher efficiency in all branches of the service.



Cardiff Exhibition Lighting.—View of Engines.

As an earnest of this, I may instance the bold but brilliant move of General Manager Littell, of the Buffalo Railway Company, in arranging to carry his patrons to divine service on Thanksgiving Day, 1896, by power generated by the waterfall of the Niagara River, over 20 miles away.

Before concluding, permit me to draw your attention to a matter which is frequently overlooked. The cost of operating a power station is frequently figured upon the basis of car miles. This is liable to be very deceptive, and may militate against a well managed station, for the reason that insufficient copper, poor bonding and defective car equipments would necessarily make a bad showing for any station.

The correct method will be to note the output at the bus bar, and figure upon the basis of electrical horse-power.

NOVEL APPLICATION OF THE LOOP TEST.

By J. RYMER-JONES.

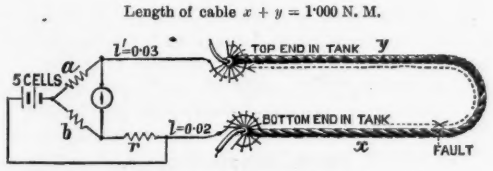
During a recent repair a mile of S.E. type, containing a fault, was picked up; but although the sheathing was damaged and kinked in several places, the position of the fault was not outwardly apparent while coiling down into the ship's tanks. For certain reasons, which it is not necessary here to dwell upon, it happened to be rather important to know the position of the fault without the delay and inconvenience which turning over would have entailed at the time. As, however, tests showed that the conductor was *entirely broken* and making earth, the difficulty was to determine the position with anything like accuracy.

An ordinary *loop test* was out of the question; nor would a "Kennelly's test," useful as that method is under favourable conditions, be of any great value when testing from either end of so short a length of cable; more especially as the resistance of the broken ends was naturally even more variable than it would have been had there been water in the tank.

In the absence of any other practicable test, the following expedient was tried and found to give a very approximate result:—

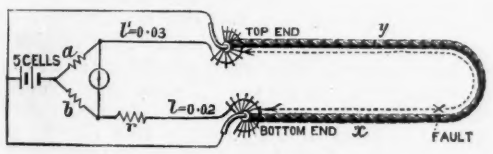
Instead of measuring the resistance of the copper conductor as is usual in a *loop test*, the order of things was reversed by measuring the relative resistance of the *sheathing wires* on either side of the broken conductor.

The following diagrams will sufficiently explain themselves:—



Measuring the resistance of the sheathing wires or loop $x + y$.
Measured resistance of loop $x + y$; including leads l & l^1 — = 0·411^w.
" " " " without " " = 0·361.

Fig. 1.



" heathing loop test."

Fig. 2.

α { (1) a=10; b=1,000; r=22·5: Therefore $x+l$=0·1845^w } = 0·1799^w
{ (2) a=10; b=10,000; r=235·7: " " =0·1754 }
β (3) a=10; b=1,000; r = 17·5; " $y+l^1$. = 0·2340

Note.—The value of r is in each case the mean of Pos. and Neg. readings.

(α) Resistance of x = 0·1799 − 0·020 = 0·1599^w;

Length of $x = \frac{0·1599}{0·361}$ = 0·4430 N.M. ∴ y = 0·5570 N.M.

(β) Resistance of y = 0·2340 − 0·030 = 0·2040^w;

Length of $y = \frac{0·2040}{0·361}$ = 0·5650 N.M. ∴ x = 0·4350 N.M.

Note.—This cable had been laid 12½ years. It was rusted near to the bottom end at the time of testing had some of the outside serving stripped off.

The actual values of x and y were found—when the section was afterwards turned over and cut—to be respectively 0·429 and 0·571 N.M. so that test α was within 14 fathoms, and test β within 6 fathoms, of the true position.

The degree of accuracy must, of course, depend on the extent of serving and compound which the sheathing wires have over them to separate adjacent turns; and a *bright* cable would introduce so considerable an error as to make the test of little, if any, value. The conjoint resistance of the sheathing wires was, however, in the case of the fault in question, relatively so small that defective insulation between turns did not greatly affect the result, which was only expected to be approximate.

It is essential that the cable shall *not* be in water when the foregoing test is applied; that *all* the sheathing wires at each end be well cleaned and connected together by a stout wire lapped several times around each wire, or, better still, soldered on, and that *both* ends of the copper conductor be used for the battery lead—as in fig. 2—in order to reduce the resistance between the broken conductor ends at the fault and the sheathing wires at that point as much as possible. Broken sheathing wires will necessarily affect the result.

Before applying the test a few hours should be allowed to elapse after the cable has been coiled down to allow the water to drain off, but not too long, as it is an advantage to test while the jute around the core at the break is still moist. As a rough expedient to meet a special emergency, the above novel application of the loop test will, no doubt, be of interest to electricians engaged in submarine repairs.

APPARATUS FOR ELIMINATING VIBRATION FROM THE SUPPORTS OF DELICATE INSTRUMENTS.

Prof. W. H. Julius, of Amsterdam, has devised an ingenious apparatus for neutralising the effect of the vibrations which are rarely completely absent from any available standing place or point of attachment in physical laboratories. Prof. Julius first described his method in *Wied. Ann.* 56, p. 151, 1895, and its principal features may be stated as follows:—

1. The instrument to be protected is fastened upon a suitable stand, which is supported on three long wires. Let the points on the beam of wall bracket to which the supporting wires are attached be called A, B, C, and the corresponding points on the stand where the wires are connected, A′, B′, C′. It can be shown that, with this arrangement, the forces which act on the instrument are much smaller than if the stand rested directly on the points, A, B, C.

2. The centre of inertia of the whole suspended system (the instrument and stand taken together) is brought to coincide with the centre of the equilateral supporting triangle, A′, B′, C′. The great advantage of this arrangement is, that the impulses starting from the supporting points, A, B, C, and proceeding along the wires, have the least possible effect in causing rotations of the system about its centre of gravity.

Such rotations would, however, be completely eliminated only when the three suspending wires are exactly identical and under the same tension, when the points, A, B, C, during the vibration, experience only simultaneous parallel displacements, and when air currents and air resistance are negligible in amount. Under these conditions the movements of all points of the body would be the same as that of the centre of gravity.

Now, it is quite possible to satisfy these conditions approximately by making the whole arrangement, as far as possible, symmetrical, and by properly choosing the point of suspension; but this cannot be thoroughly carried out in practice, and the consequence is that the different points of the suspended system are subjected to disturbances proportional to their distance from the centre of gravity, in addition to the displacement which they have in common with the centre of gravity.

Accordingly, if there is in the instrument a special point, P, which it is desired in preference to all others to protect from the influence of vibrations, as, for instance, the point in a galvanometer, to which the quartz or silk fibre of the magnet system is attached, then this is best done by bringing this point as near as possible to the centre of gravity.

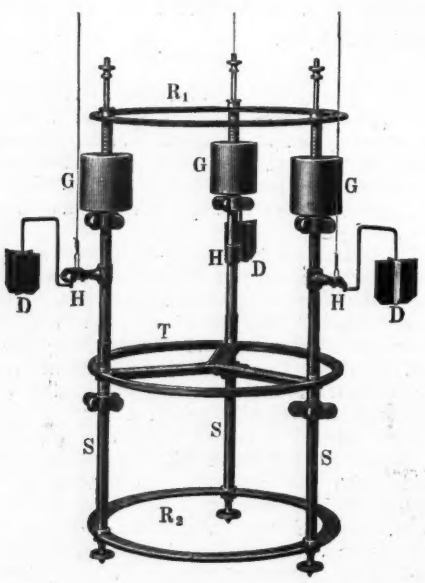
In his earlier apparatus Prof. Julius made no provision for making this adjustment, but in an apparatus described in the *Zeit. f. Instrumentkunde*, September, 1896, he shows a very simple and efficient method of carrying out this last refinement. The improved apparatus has been made by P. J. Kipp and Zonen (J. W. Giltay), of Delft, and has been found already, in several laboratories, to work very

satisfactorily. This apparatus is illustrated in the accompanying figure, and may be described as follows:—

Three rods, S, are screwed together by means of two rings, R_1, R_2, to form a stand. Strong hooks, H, are fixed on the rods to suspend the apparatus. The points of these hooks, where the loops of the suspending wires rest, determine the three corners of the equilateral supporting triangle, A′, B′, C′. Upon each rod there is a sliding lead weight, G; the rods are marked with a scale of equal parts above the hooks, H, and the weights can be fixed at any height by means of a split cone and winged nut.

A third ring, T, is mounted so that it can be displaced along the rods, and clamped at any required point by similar fly nut clamps; it forms the table plate of the stand, upon which the instrument to be protected is placed, and to which it is firmly fixed by attached clamps.

The adjustment is made as follows:—The stand is set upon a table, and levelled up by means of its screw feet, the suspending wires having previously been disconnected from the hooks. The ring, T, is then fixed at such a height, that the point, P, of the instrument lies in the plane, A′, B′, C′. The instrument is at the same time levelled and clamped to the stand.



It is now necessary to bring the centre of gravity of the whole system into the plane A′, B′, C′. For this purpose the whole arrangement is turned on its side (of course after the sensitive part of the instrument has been removed), in such a manner that the hook on the left hand of the figure lies uppermost. The wings, D, by which the damping of the oscillations of the stand itself is effected, must not be screwed on till after this operation is complete. The apparatus, for the present, is suspended by the one hook, H, and the weights, G, are displaced till the rods, S, lie horizontal. Care must be taken that all the three weights are fixed at the same divisions on the scales.

When the instrument to be protected is very heavy, and its centre of gravity is low, so that the movable weights are not capable of producing equilibrium, auxiliary weights can be fixed on the continuations of the rods on the other side of the ring, R_1.

After the weights have been clamped in the correct position, the stand is restored to the vertical position, and set upon its screw feet. The loops of the suspending wires are slipped on to the hooks, H; the dampers, D, which are afterwards to be dipped into vessels containing paraffin oil, are then attached.

The sensitive part of the instrument is now fitted in, and the table on which the stand rests is slowly lowered, till the arrangement is left suspended on the three wires. If the level of the apparatus is at all disturbed by this operation, the wires must be shortened or lengthened at their suspension points, A, B, C. In order that this may be readily carried out, the wires are furnished with a tripod having three clamps, which is fastened by a strong screw bolt to the ceiling of the room, or better still, to a separate beam. The exact adjustment of the wires may be done once for all; the small adjustments which are necessary to allow the system to hang free, are best made in the usual way, with the screw feet of the instrument, if no essential displacement of the point, P, is caused thereby. In the illustration the whole arrangement is shown, with the exception of the tripod and the three clamps for fastening on the instrument.

INTERIOR WIRING.*

Switch Control.

Switch control has been considered by many to be a problem that solves itself. This may be the case when the general excellence of the result is unimportant, but when other conditions prevail every hint is welcome.

The position of the switch is an important point, but an electrician or engineer is not necessarily the best judge of this. An architect is frequently even more competent, and the owner of the building to be wired, while not conversant with current practice, usually has sound ideas on such matters when various common methods are submitted to him.

As a general thing, in small rooms the place for the controlling switch, if there is one, is near the door on the knob side. The first thing desired when entering a dark room is light, and with the switch thus conveniently at hand it can

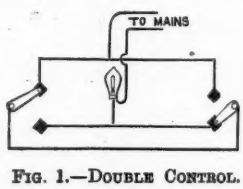


Fig. 1.—Double Control.

at once be had without advancing further. Similarly, on leaving the room the last thing is to extinguish the light, and it is never convenient to do this by a switch near some desk in the rear of the room, and then meander to the door in the dark. It would seem that this location for a switch is so obvious as not to need pointing out, but judging from a number of personal experiences searching for a switch in hotel rooms, this is not the case. In one large hotel in New York City, it is necessary to have the electrician show the location of switches to new guests, as they may be behind an inner door in a closet, behind the head board of a bed, &c.—the switches apparently having been placed with reference to easy wire runs rather than with any thought of convenience in use.

There are, however, many special cases where this rule by no means applies. In lighting a cellar it is convenient to have the switch at the head of the stairs in the room above. The same is true of hallways. In halls and theatres the switches are usually banked in a cabinet near the stage in a little room adjacent thereto. In all such cases when the operator cannot see the lights he is manipulating, the switch should show by its position whether it is on or off. In a sleeping room, while it is convenient to have a switch near the door in the ordinary way, it is often required that a switch be placed within easy reach of the bed, so that the room can be lighted without arising.

Fig. 1 shows an arrangement of connections whereby the lights can be controlled at will from either of two positions, irrespective of the other switch. This is also an excellent device for halls and gangways, where it is desirable to light the hall on entering, and to extinguish it at another point after passing through.

Two single-pole, double-throw switches are used. The connections are as shown in the sketch. By tracing the connections it will be seen at once that the lamp is lighted and extinguished by throwing either switch, as they are in series with each other. If, however, one switch be thrown so that the lamp is out, the latter may be relighted by throwing the

* *American Electrician.*

other switch to the side that formerly extinguished the lamp. In short, the lamp may be controlled from either station entirely independently of the other. Two-point snap-switches are now made for just such cases as these.

Another arrangement that is occasionally useful is shown in fig. 2, and intended to limit the control of a main switch. For example, suppose the case of a gymnasium or hall in an establishment such as a boarding school. In such a case it may be desirable to limit the number of lights that can be turned on in the room by the occupants. To do this a single large switch is placed in the room, and is conveniently at hand for those who desire to use it. From this switch, which should ordinarily be a double-pole switch to comply with insurance rules, circuits branch, in each of which is a single-pole switch located in a cabinet under the control of the

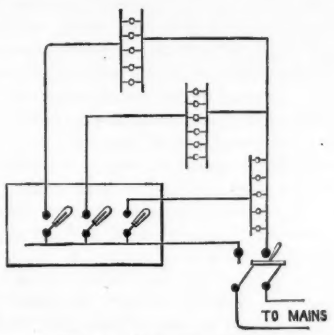


Fig. 2.—Limited Control.

manager of the building. It will at once be seen that he has complete control of any or all of the circuits, as long as the main switch is thrown. Thus, if the case is that of a gymnasium, which is to be closed at a certain hour, he can at that time extinguish the lights in the gymnasium, and leave those in the bath rooms and lockers burning. As the last man leaves the room, he throws the main switch, thus leaving the entire room dark. In due course, the switch controlling the bath and locker room lights may be thrown, and thus render general extinction certain in case the last man to leave has been negligent. In other cases, also, this device may be useful.

In some cases it may be convenient to reverse the arrangement; that is, to have the main switch under the control of the janitor, so that when he leaves the building for the night, he can do so in full confidence that all lights are out, without making a tour of the premises. In any building receiving light from a local lighting company, a large jack knife switch should be put in back of the meter, to be opened in case the building is locked up for the summer or similarly left to itself for a period of time. In such a case a plug switch, of which there are several types on the market, is convenient. With such a switch the plug can be removed and locked up, thus effectively preventing the closing of the switch by unauthorised persons.

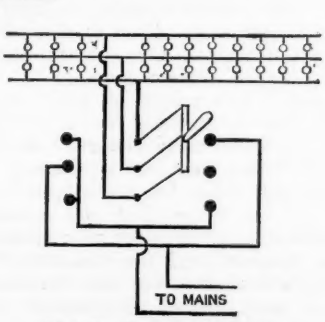


Fig. 3.—Theatre Control.

The theatre is, perhaps, the place where the greatest ingenuity in switch control can be utilised, as so many different effects are desirable—the more the better. In such a place it is necessary to control the brilliancy of the lights. In the flies, side and foot-lights, their brilliancy must be completely under control, for any grade of illumination is likely to be needed. In the main house, however, it is not necessary to have such complete control of the brilliancy of the lamps, and if this control were done by the ordinary method of resistance in series, it would be extremely wasteful of power where so many lights are in circuit. This is an important factor where the consumer uses a meter.

The main body of the theatre should be wired on the principle shown in fig. 3. This will render resistance unnecessary. It will, it is true, give but two gradations of brilliancy, but it will avoid both the first cost and subsequent waste of regulating resistances. It is sufficient for the cheap theatres and concert halls, and is not out of place in the main auditorium of more elaborate establishments. It will be seen that the device simply connects the lamps in series or multiple across the mains, by the throw of a double-throw, three-pole switch.

If the contractor has facilities, he can make the special switch shown in fig. 4, and thereby offer his customers a control having three steps, namely: All the lamps at full voltage—half the lamps at full voltage—all the lamps at

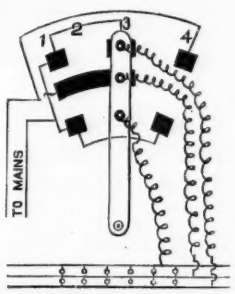


Fig. 4.—Triple Control Switch.

half voltage. Such switches controlling the circuits in a theatre auditorium would give a gradation that should satisfy the most fastidious proprietor. It will be noted that there are really four steps to the switch; that is, either half of the lamps are available. Remembering that when the performance has begun, the lights in the lobbies and ante-rooms are unimportant, it may easily be seen that these lights may be worked in as a part of one of the halves of the theatre circuits. By this simple means the halves, though equal in number, will be unequal in the auditorium of the theatre, and thus four instead of three grades of light are obtained therein.

If it is not desirable to have the lights in the lobbies vary up and down in this manner, the extra portion of the half

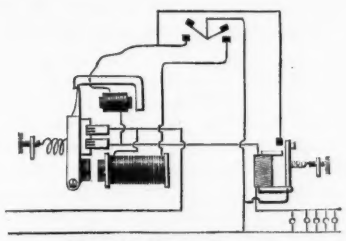


Fig. 5.—Relay Switch.

giving the least grade of illumination at full candle-power may be formed into an electric sign on the front of the building. The fluctuation of the lighting of this sign will serve to attract attention to it from the street, and means may be provided for lighting it independently. In any of the combinations, the theatre manager is getting some good out of all his current, and none is wasted in heating resistance. Moreover, such switches as those described can be made at much less cost than a controlling rheostat.

It is to be understood that the switch shown in fig. 4 is merely diagrammatic, and that it needs to be suitably designed mechanically. It may be added that the three studs on the switch arm are not electrically connected, but merely make contact with the plates beneath them, as the switch arm swings over. Such a switch could really be designed on the principles of a street car controller.

The brilliancy in sign lamps can be raised in the same

way. In a large electric sign with two circuits thus controlled, the manipulation of the switches will at once attract attention. The circuits should be so arranged that their lamps alternate with each other on the sign.

There are several types of switches now on the market known as relay switches. The actual switches themselves are operated by magnets, the circuits of which are controlled by buttons. Pressing one push button energises a magnet and tightly closes a switch, and a little latch keeps it from flying open. A second button operates a magnet which trips this catch and opens the circuit. By a very simple device this switch is also made to act as a circuit breaker. A coil of wire in series with the circuit to be protected is adapted to raise an armature and close the trip magnet circuit whenever the current becomes excessive.

This circuit breaker once installed needs no attention. It resets itself, and will not stay closed till the trouble is removed. Another feature of the switch lies in the fact that the duty of the trip magnet is very light, and it will, therefore, respond with great accuracy to the current for which it is set. There is no reason why this switch should not find favour. Fig. 5 is a diagrammatic view of the connections of a single-pole switch of this type. The next section will discuss switch control as applied to electric signs and decorative lighting.

THE QUESTION OF FAST SPEED SUBMARINE CABLES.

The interest which has centred on the recent paper read by Mr. Preece before the British Association has hardly led to the amount of discussion on the subject which is desirable. A very considerable conflict of opinion exists; a conflict which has very largely arisen from the various parties not quite understanding what each one intends to express, and consequently each one mildly accusing the other of making assertions which the wording of the latter may mean, but which actually mean something quite different. The actual or intended meaning of the two terms, "self" and "mutual" induction, does not yet appear to be clear, and doubtless the confusion of thought which has taken place as to the significance of the two terms has much to do with the misunderstandings which have existed. Mr. Preece, when speaking of mutual induction, apparently refers to the induced current which is set up in one wire by the action of a current flowing in another wire in the proximity of the first, and he argues that this induced current can be made effective in reducing the static effect which is also set up between the two wires. If this is Mr. Preece's theory, it appears to us that he has entirely omitted from his calculation the fact that not only does a primary current induce a secondary current in a neighbouring wire, but it also induces a secondary current in the wire through which it itself flows, which latter secondary current is by many understood to be the self-induction current. Assuming, then, that mutual and self-induction have the significance we have indicated, it would appear that the effect of the mutual secondary current is to counteract or cancel not the static effect, but the self secondary current. The closer two wires come together, the more does the mutual approach in strength to the self, and consequently the more does it tend to produce nullity. This is what takes place when two wires are close together, as in the case of the double-wound wire on resistance coils, the resultant dynamic inductive effect being, as is well known, practically *nil*. But the bringing into close proximity of two wires obviously greatly increases the static effect between the two. In the case of a cable designed according to Mr. Preece's theory, it would seem then as if the good effect of cancelling the self-induction by the mutual induction would be far more than counteracted by the greatly increased static capacity. As, however, the ratio at which static capacity increases by the diminution of distance is greater than the rate at which mutual induction (using the term in the sense indicated) increases, there must apparently be some point at which a minimum retarding effect, due to the dynamic and static forces, will be obtained. What this distance is, *i.e.*, whether it is at a distance of several inches, or only a fraction of an inch (as in the proposed cable), remains to be determined, and can best be determined experimentally. Should Mr. Preece prove to be practically correct, and he is theoretically in conflict with high authorities, we think that he will have arrived at a correct conclusion from incorrect premises.

THE VIEWS OF A FIRE OFFICER ON CENTRAL STATION INSURANCE.

The following views of a prominent Fire Officer on the subject of the insurance of central stations, are interesting at the present moment:—

"The notion that fire risks can be dealt with individually, and upon their own merits, is wholly impracticable. They can only be lumped as a class and dealt with accordingly. At the present day fire insurance is based upon an elaborate system of classification—the outcome of the combined experience of the various offices extending over a period of years. An underwriter cannot of course look for a profit on every class in each year, but he does expect to show a profit upon any class over a period of, say, 10 years. Should he fail to do so, he knows he has underrated the risk, and acts accordingly. Now, electric light stations form a class to themselves, possessing a risk that is not common to others. Unfortunately they are not a numerous class, hence a few fires will seriously affect the loss ratio. Being a creation of recent times, the underwriter was without experience in them. He had—so to speak—a free hand, and accordingly plunged, taking them freely at 2s. 6d. per cent. After 10 years experience, however, he found a woful balance against him, and he is now endeavouring to recover his ground by raising his rates. It is said, on the other hand, that the increase is exhorbitant and unjustifiable. Well, let us see how it works out.

"At the present time there are about 80 stations in the United Kingdom. Five years ago there were nothing like so many; but let us put the average for the past 10 years at 60. Next, assume an average insurance upon each at £20,000—a very full estimate, as I happen to know. That gives a total sum insured of £1,200,000. Now, the average rate during the past 10 years upon those stations would not exceed 3s. per cent., and that represents a total annual premium of £1,800—or say, in round numbers, £2,000. It will be admitted, I think, that that does not allow of many ducks and drakes in the shape of fires in a year. Multiplying our £2,000 by 10 (representing the period in question), we get a total of £20,000 upon that class in the shape of premiums received. (Of course, commission and managerial expenses should be deducted.) Now for the other side of the account. Although I cannot give the exact figures, I do know that the losses upon that class during those 10 years *exceeded* £65,000, showing a deficit of at *least* £45,000—equal to nearly 23 years premiums at the old rates! With these facts before him, the underwriter could do no otherwise than raise his rates. Doubling was not enough. The present average rate upon that class of risk is about 8s. per cent. Even at that advanced rate it will take about 10 years to wipe out this deficit, *assuming there are no more fires in the meantime!*

"To myself, it is a matter of much regret that there should have been the necessity for such a heavy increase in the rate. I know many stations that are admirably designed, well looked after, and in which it is difficult to conceive how any serious fire can happen. On the other hand, there are not a few which are crowded to excess, having wooden flooring saturated with oil surrounding the engines and dynamos, and the switchboards encumbered unnecessarily with highly-dried and varnished woodwork. I should be sorry, indeed, to guarantee such places a further 10 years' life. But I am happy to know that engineers are now alive to the necessity of reducing the fire risk as much as possible, and in time doubtless the *average station* will be a very much improved risk to what it has been in the past.

"I refrain from saying anything on the score of a mutual insurance scheme, being naturally a little biassed; but I have sufficient faith in the wisdom of the majority of you gentlemen to keep you clear of *that* rock."

THE OLDHAM REFUSE DESTRUCTOR TESTS.

In our issue of September 4th last, we made some comments on the value of refuse destructors, and specifically referred to some tests at Oldham, which were given in the columns of a contemporary. The figures upon which we based our remarks were published on August 27th, and, as we were afterwards informed, they did not fully represent the matter, we have instituted further inquiries, with the result that we are able to give complete details of the tests made on a plant which we are credibly assured was not originally laid out for steam raising at all. Naturally this makes a very material difference, for with a new plant specially devised for the production of steam power, more favourable figures would be forthcoming.

Respecting the actual tests, of which we published certain particulars, we have received the following data from the Horsfall Refuse Furnace Company, Limited, which we have every reason to believe are as noted at the time. So far as the plant is concerned, we have been to Oldham specially, and have seen this for ourselves, and the plan accompanying this article gives a correct representation of the position and some dimensions of the apparatus on which we are informed the tests were carried out:—

Duration of test	= 24 hours.
Total refuse burned	= 79 tons, in 10 cells.
∴ refuse per cell per 24 hours ...	= 7·9 ,,
Total water evaporated	102,700 lbs.
Total water evaporated per cell per hour	= 428 lbs. during whole test. = 486 lbs. during latter half of test.
Water evaporated per lb. of refuse during whole test ...	= ·58 lbs.
Average steam pressure	= 127·2 lbs.
Average temperature of feed-water leaving economiser ...	= 315° F.
Average temperature of gases leaving at back of economiser	= 657·5° F.
Average temperature of mattrass cremating chamber (between cells and boiler)	= 1,800° F.

A further test was made to find the steam consumption in forcing the draught by steam jets as follows:—

Total steam evaporated per hour per cell (10 cells) = 188·75 lbs. (Total for 10 cells = 1,887·5 lbs.)

Average steam pressure = 124 lbs.

(N.B.—The pressure was purposely kept down to avoid blowing off.) Not allowing for the reduced pressure, this leaves a total of steam available from the 10 cells during the whole test of 2,392 lbs. per hour.

The company wishes it to be here stated that owing to some of the cells having been stopped just previous to the test and lighted up just in time to start the test, they did not get really hot until the test was at least half over; and probably even then the maximum heat was not attained. Therefore, the second half of the test may be taken as a normal result as follows:—

Total steam available from the 10 cells = 2,972 lbs. per hour.

Further, it should be noted, that the average temperature at the back of the economiser was 657·5° F. This is on account of the insufficient heating surface of the boiler. Were the gases reduced to about 300° F. by additional heating surface, the steam available, it is claimed, would be increased in proportion as follows:—

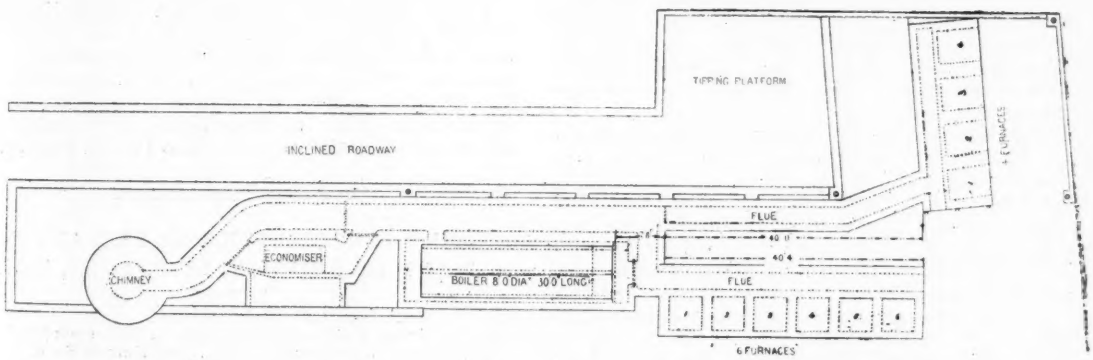
Total water evaporated (if gases were reduced to 300° F.) per cell per hour	= 638·4 lbs.
Steam required for blast	= 188·75 lbs.
Steam available	= 449·6 lbs.
Total steam available	= 4,496 lbs. per hour.

It may be objected that 300° F. is below the actual temperature of the steam; but it should be noted that it is proposed to reduce the temperature of the gases not by means of the heating surface of the boilers, but by the feed water heater, which is, of course, quite possible. Further, it may be said that the gases entering the chimney at 300° F. would not produce sufficient draught. To this it is replied that the draught is forced in the cells themselves, so that a strong chimney draught is therefore unnecessary.

Now as to the steam used by the jets, it may be said that four out of the 10 cells at Oldham are fitted with old-fashioned steam jet apparatus, noisy, and comparatively wasteful, and without the company's new patent side boxes, which assist in the economy of steam by superheating the blast, and also prevent the clinker from sticking to the sides of the furnace.

This improved silent forced draught apparatus is in use at the destructor erected by the company at Hamburg, which consists of 36 cells, being the largest installation of refuse furnaces in the world. There the company claims to have proved that 120 lbs. of steam per cell per hour, at 80 lbs. pressure to the square inch, is sufficient for the blast. At, say, 130 lbs. pressure, then 74 lbs. of steam, or, say, 80 lbs., should be sufficient for one cell per hour, which would leave, say, 558 lbs. of steam available per hour.

So far we have dealt with ascertained facts, and we will therefore, work out the result at this point.



Second Half of 24 Hours' Test.

Refuse burned per cell per 24 hours ...	= 7·9 tons.
∴ Refuse per cell per hour	= 737 lbs.
Total steam available per cell per hour at about 130 lbs. pressure per square inch	= 558 lbs.
(Provided there were heating surface sufficient to reduce the gases to 300° F., and that the most improved jets were in use on all cells.)	
∴ total steam per pound of refuse burned	= ·76 lb.

Now, if we refer to the plan and to the following observations, it will, we think, be admitted that the above is a very excellent result, and one proving conclusively that 1 lb. of steam per pound of refuse is a very moderate estimate of the amount to be obtained in a plant laid out for the purpose.

1. The test was made on June 25th and 26th last, in midsummer, when, of course, the minimum of coal cinders were found in the refuse.

2. The test was carried out under the then normal conditions. The stokers were left purposely to themselves, in

order that they might not give any more heat than could be counted upon at all times.

3. Four of the furnaces are connected by a flue above ground, 50 feet long, with the boiler. All the furnaces are further separated from the boiler by a large mattrass cremating chamber.

4. The boiler itself is not in a good position, and there is radiation from the boiler setting.

5. Further heat is lost in the flues between the boiler and economiser.

In the opinion of Mr. Watson, the company's engineer, the above losses amount to 50 per cent. of the total heat. If this be true, the evaporation per pound of muck ought to be, instead of ·76 lb., 1·14 lb.

Now, the company claims to have proved with this imperfect plant that a combination of destructor and electricity station is always desirable, *in this country*, where special difficulties in regard to site or other matters do not prove insuperable.

The electric light station, it is presumed, should be as nearly as may be in the centre of the district. So, says Mr. Watson, should the destructor, in order to avoid cartage. There is no danger to health, and no nuisance from a properly constructed destructor, according to the report of Mr. Estcourt, the well-known analytical chemist. Further, the company is prepared to guarantee that there shall be no nuisance from their destructors.

The only drawback to the nearest neighbours is the passing of the refuse carts; but a greater injustice would be inflicted by placing the destructor on the outside of any given district, because then *all* the refuse would come along one main street, instead of coming along radial streets to a central position.

As to the actual results obtainable, the company is prepared, after its unique experience in the matter, to guarantee *1 lb.* of steam (available) "per pound of muck," in any London parish, raised to a pressure of 140 lbs. per square inch, as an average figure, for summer and winter. It is a fortunate circumstance that summer is the time when less light is required, because then there are fewer cinders available.

It may be urged, possibly with a certain degree of truth, that the garbage of Oldham forms no criterion of the worth of metropolitan refuse; indeed, we are convinced that the former is richer in useful combustible material, but as a set-off against this Mr. Watson calls attention to the fact that the refuse of London is very much drier, which reduces things to about the same level.

It is also claimed to be quite an easy matter to arrange the working of the destructor to cope, to a great extent, with the time of "high load" in this way:—

Take the case of a 12-cell destructor, which would deal with the refuse of a population of 120,000. It has been found by experience that the most economical rate of combustion is eight tons per cell per 24 hours, as an average. Four stokers in each shift can burn it at this rate (working eight hours per day), each man doing his own charging and clinkering.

But we require the most steam during, say, eight hours; and probably not so much as the destructor by itself will furnish during the other 16 hours.

Then if we arrange for two shifts, each of three men instead of four, they will burn at the rate of six tons per cell per 24 hours (instead of eight) for those 16 hours.

For the remaining eight hours, put on, in addition to the normal four men, the two men standing out of the other two shifts, or, in all, six men during the eight hours of high load; then these six men will burn at the rate of 12 tons per cell per 24 hours for those eight hours.

This is a matter of arithmetic, and it is amply borne out by the Horsfall Company's experience at Leeds and Oldham. The company adds, in parenthesis, that on this system it is easy to largely increase the capacity of the destructor at times when the quantity of refuse becomes embarrassing, simply by adding one man, or two men, in one or both of the "easy" shifts.

It should be borne in mind that the whole cost of working the destructor must be incurred anyhow, in order to burn the refuse, which at present, in almost every London parish is being—not *really* got rid of, but simply shifted under somebody else's nose—at a very much higher cost than that involved in destruction.

On this system, the day would be arranged as below:—

Say, 1 a.m. to 9 a.m.	9 a.m. to 5 p.m.	High load. 5 p.m. to 1 a.m.
Three stokers. Rate of combustion = six tons per cell per 24 hours.	Same as last.	Six stokers. Rate of combustion = 12 tons per cell per 24 hours.
Amount burned in the eight hours = 24 tons. Steam raised (available) per hour = 6,720 lbs. per hour at 140 lbs. pressure = say 336 I.H.P.	Say, 336 I.H.P.	∴ amount burned = 48 tons. Steam raised per hour (available) = 13,440 lbs. (at 140 lbs. pressure) = say, 672 I.H.P.

The number of "stand-by" boilers in the electricity station can be reduced by just the number of boilers used in conjunction with the destructor, so that no additional expense need be incurred on the score of boilers.

At least, a case for the establishment of one or two combined plants seems to have been made out, for even supposing *the worst*, the destructor would still be there, and of immense use for burning refuse.

We stated at the conclusion of our previous article that knowing a little about the varying quality of refuse, we would accept no results based upon a 24 hours' test, and without additional corroboration we should still adhere to what we then said, but the Horsfall Refuse Furnace Company's experience is so extensive, that they can, if necessary, bring forward innumerable instances which go to prove their contentions, so that any figures put forward by them for a 24 hours' run are more than likely to be a fair average of what may be expected in daily use, and what is more to the point, they are prepared to guarantee their figures, so that customers have the remedy in their own hands if the results do not come up to specification.

We checked Mr. Watson's temperatures, and assuming that his pyrometer gave approximately accurate readings, and that the melting points of certain metals had been correctly determined, we can substantiate his results.

Finally, through the courtesy of Mr. Wilmott Newington, borough electrical engineer, we were shown through the Oldham electric lighting station, which is separated from the destructors by only some 20 yards. Here, since April last, from 80 to 100 horse-power has been utilised each evening, supplied entirely from the boiler heated by the refuse cells, the steam in the boiler being raised to 140 lbs. pressure.

BRITISH ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE, LIVERPOOL, 1896.

SCREW GAUGE.

Report of the Committee, consisting of Mr. W. H. Preece (*Chairman*), Mr. Conrad W. Cooke (*Secretary*), Lord Kelvin, Sir F. J. Bramwell, Sir H. Trueman Wood, Major-Gen. Webber, Mr. R. E. Crompton, Mr. A. Stroh, Mr. A. Le Neve Foster, Mr. C. J. Hewitt, Mr. G. K. B. Elphinstone, Mr. T. Buckney, Col. Watkin, Mr. E. Rigg, *and* Mr. W. A. Price, *appointed to consider means by which Practical Effect can be given to the Introduction of the Screw Gauge proposed by the Association in* 1884. (*Drawn up by the Chairman.*)

(*Concluded from page* 489.)

Appendix I.

Enlarged Shadow Photographs of Screws. By Col. Watkin, C.B., R.A., &c.

The objects aimed at in producing enlarged photographs of screws are:—

(*a*) To provide a means of verifying the accuracy of the shape of a thread.

(*b*) To provide a means of accurately gauging the dimensions of screw threads.

(*c*) To provide a record or certificate of a screw, in a similar manner to the certificate of accuracy given by Kew Observatory.

As in this process a standard scale is photographed at the same time as the screw, a direct reading to any desired accuracy can be obtained. There seems to be hardly any limit to the amount of enlargement, as the difficulties inherent to the enlargement of an ordinary negative do not apply to this process.

The question arises, does the shadow photograph give accuracy as regards

1. Dimensions,
2. Shape of thread?

To test (1) a No. 2 B.A. thread was enlarged 37·18 times. The linear dimensions could in this photo be measured to at least $\frac{1}{5000}$th of an inch.

The diameter, pitch, and angle of thread of this particular screw were gauged by a member of the Committee, and found to be:

By an Elliott gauge	0·1818	diameter.
By a Brown and Sharp gauge	0·1820	
	0·03184	pitch.
	54°·30′	angle of thread.

Standard Glass Scale, lines at intervals of ·02 inch. (Photograph reduced from the original.)

The photo gave the following:—

0·1818 diameter
0·03181 pitch
54°·30′ angle of thread.

Fig. 1 shows a reduced copy of an actual photograph and scale.

As regards (2) there has been considerable discussion as to whether the shadow photograph gave the true shape of the thread. There are two methods of obtaining a photograph of a screw thread: one in which the axis of the screw is at right angles to the beam of light; the other in which the axis of the screw is inclined at an angle which differs from the right angle, by the angle of the pitch of the screw.

As regards the first method, a mathematical consideration worked out by Mr. Price seems to show that a slight correction of about $\frac{1}{8}°$ in the total angle of the screw thread would have to be made. I think, as regards the second method, no correction is required. In any case, the correction is so small that for practical purposes it might be neglected, as on a No. 2 B.A. thread it only represents about $\frac{1}{7000}$ of an inch, and proportionately less on the smaller sizes.

However, to determine practically whether this was the case, I suggested filing away a part of the screw to be photographed to make it a comb. There could be no doubt that the photo of such a comb

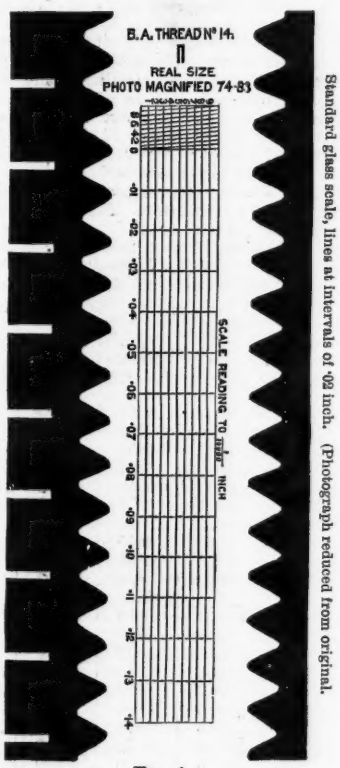

B.A. THREAD N° 14.
REAL SIZE
PHOTO MAGNIFIED 74·83
SCALE READING TO 1/100 INCH
Standard glass scale, lines at intervals of ·02 inch. (Photograph reduced from original.

Fig. 1.

would give the true shape of the thread. Mr. Stroh kindly supplied such a screw. From the photos it would appear that there is no practical difference in the shape, and that therefore the photograph of a complete screw gives a true record of the shape as well as the dimensions.

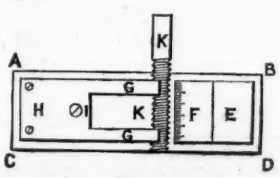


Fig. 2.

The following gives the detail of the method employed in photographing the screws:—

On a plate A, B, C, D, fig. 2, is a block E, to which is secured a glass scale F, which has been carefully etched with lines $\frac{1}{50}$ inch apart. A piece of spring brass, H G, serves to hold the screw K K to be photographed, with its axis parallel to the plate A, B, C, D. The distance of the screw from the plate can be adjusted by means of the screw I, so that when the scale is sharply focussed on the screen, the shadow of the screw may also be brought into focus.

The frame A, B, C, D, fig. 2, is adjusted in the same position as an ordinary microscopic slide in a magic lantern arranged for microscopic work; only I found it desirable to employ a photographic lens of modern design instead of the usual objective.

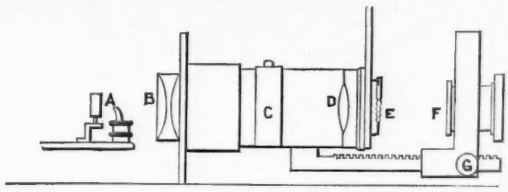


Fig. 3.

The arrangement is shown in the accompanying diagram, fig. 3, where

A represents the limelight.
B the ordinary condenser.
C Alum trough to stop the heat rays.
D Small condensing lens.
E Screw, in its frame as described in fig. 2.
F Photographic lens.
G Milled head screw for focussing the lens F.

APPENDIX II.

Gauges for Verifying the Accuracy of Screws (for Workshop Use only).

By Mr. A. Stroh.

In the gauge represented in fig. 4 the hole *a* is for the external diameter. It should be of exactly the diameter given in the table of sizes for B.A. screws. A screw should pass into this hole freely, but without much shake. The hole *b* is the minimum gauge, and the screw should *not* pass into this hole. The difference of diameter between the holes *a* and *b* has not yet been determined by the Committee; in the present case it is ·0015 inch. *c* is a threaded hole or female gauge in which a screw should just turn freely. The hole *d* is for the diameter of the core, but as it is impossible, without turning down some of the threads of a screw, to pass the core of it into this hole, the gauge *e* is provided for gauging the core, or in other words, the depth of the thread. It consists of a fork, the inner

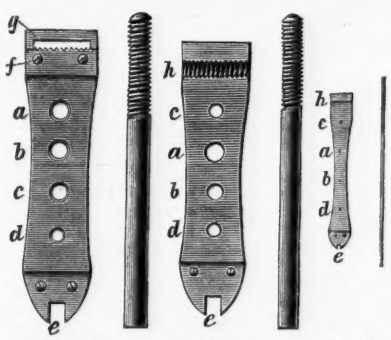


Fig. 4. Fig. 5. Fig. 6.

edges of which are shaped so as to enter between the threads of a screw. The correctness of the pitch of a screw is ascertained by placing it in the comb *f* and against the back-rest *g*, and by holding the gauge against the light or a white paper.

It has been found by practice that there is considerable difficulty in making these combs with any degree of accuracy, and also that it would be almost impossible to carry out the above form of gauge for the smaller sizes. It is therefore suggested that the gauge represented in fig. 5 has certain advantages over the comb-gauge. With this the half-nut *h* is employed for verifying the pitch of screws, instead of the comb. The half-nut can be carried out with greater certainty and ease, and is therefore less costly, and there is no

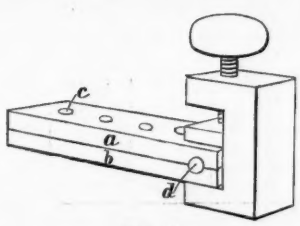


Fig. 7.

difficulty in making it for the smaller sizes, as shown in fig. 6. Gauges on the principle of figs. 5 and 6 have also the advantage of being more compact and stronger for workshop use.

The process of making the half-nut gauges is the following:—Two have to be made at one time. When the two steel bars intended for the gauges are filed to shape they are placed together, as shown in sketch (*a* and *b*); a temporary rivet or bolt is put through the hole *c*, and the ends intended to receive the half-nut device are clamped

together as shown. A hole of the diameter of the core is then drilled across the two bars at *d*, so that each bar receives one half of it. The clamp is then unscrewed, the bars are slightly separated, the tap is inserted between them, and the clamp screw tightened again gently. Of course, now the two steel bars cannot meet, being prevented by the insertion of the tap. But the smooth end of the tap is now fixed in a chuck on a lathe, and is rotated forwards and backwards, while the clamp screw is tightened from time to time. This is carried on till the threads forming the half-nuts are complete. It is only necessary towards the end of the operation to separate the bars once or twice for the purpose of removing the bur which is raised by the operation.

Appendix IV.

Working Dimensions in Millimetres and Thousandths of an Inch.

No.	External Diameter.		Diameter of Core.		Difference of Diameter.	Pitch.		Working Margin.	
	mm.	inches.	mm.	inches.	mm.	mm.	Threads per inch	mm.	mils.
0	6·0	·236	4·8	·189	1·2	1·0	25·4	·05	·002
1	5·3	·209	4·22	·166	1·08	·9	28·2	·05	·002
2	4·7	·185	3·72	·147	·972	·81	31·4	·04	·0016
3	4·1	·161	3·22	·127	·876	·73	34·8	·04	·0016
4	3·6	·142	2·8	·110	·792	·66	38·5	·04	·0016
5	3·2	·126	2·5	·0984	·708	·59	43·0	·03	·0012
6	2·8	·110	2·16	·085	·636	·53	47·9	·03	·0012
7	2·5	·098	1·92	·076	·575	·48	52·9	·03	·0012
8	2·2	·087	1·68	·066	·516	·43	59·1	·02	·0008
9	1·9	·075	1·43	·0565	·468	·39	65·1	·02	·0008
10	1·7	·067	1·28	·0505	·420	·35	72·6	·02	·0008

Mr. Foster informed the Committee that in the experience of his firm these limits are found to be convenient for all screws connecting ordinary pieces of mechanism.

Tests of B.A. Screws by Hervé Diameters.

Of the measurements given in the following table all, excepting the No. 8 steel and No. 11 brass screws, were made with a gauge of which the zero was out of adjustment. The measures to be reduced by ·0002 in the first 9 columns.

These measurements were made to ascertain within what limits a screw maker can work, not as chausson screws with their theoretical diameters.

It seems that 1·2 inch below the full diameter is all that is required for brass screws Nos. 0 to 11, and that the same is required for all sizes.

It is clear that steel screws are more troublesome than brass, but the lot of No. 4 steel examined were probably not made with sufficient care.

The margins are:

1·2	1·0 (1·6)	·9	1·1 (3·2)	·9	1·8 (3·0)	·8	1·2 (2·1)	1·0	1·2 ·9 (1·5)

The figures in brackets in each case include the screws, even those that are clearly too small to pass.

The No. 11 brass screws were a lot that Hervé had been asked to make with especial care.

No. 0 Brass.	No. 0 Brass.	No. 2 Brass.	No. 2 Steel.	No. 4 Brass.	No. 4 Steel.	No. 6 Brass.	No. 6 Steel.	No. 8 Brass.	No. 8 Steel.	No. 11 Brass.
·2373	·2385	·1852	·1852	·1424	·1438	·1110	·1111	·0865	·0860	·0595
·2372	·2382	·1850	·1851	·1424	·1437	·1109	·1110	·0864	·0858	·0594
·2371	·2382	·1850	·1851	·1423	·1434	·1108	·1110	0863	·0857	·0594
·2370	·2380	·1849	·1851	·1422	·1434	·1106	·1110	·0861	·0857	·0594
·2370	·2380	·1849	·1850	·1421	·1433	·1108	·1110	·0860	·0857	·0593
·2370	·2380	·1849	·1850	·1421	·1432	·1106	·1110	·0860	·0857	·0593
·2370	·2380	·1849	·1850	·1421	·1431	·1105	·1109	·0860	·0855	·0593
·2370	·2379	·1849	·1849	·1421	·1431	·1105	·1109	·0860	·0855	·0593
·2369	·2379	·1848	·1848	·1420	·1430	·1104	·1109	·0859	·0855	·0593
·2368	·2379	·1848	·1848	·1420	·1430	·1103	·1109	·0859	·0854	·0593
·2368	·2378	·1848	·1848	·1420	·1430	·1103	·1109	·0859	·0854	·0592
·2367	·2378	·1848	·1847	·1420	·1429	·1103	·1109	·0859	·0854	·0592
·2367	·2378	·1848	·1845	·1419	·1428	·1103	·1109	·0859	·0853	·0592
·2365	·2378	·1848	·1844	·1419	·1428	·1103	·1109	·0859	·0852	·0592
·2364	·2377	·1848	·1843	·1419	·1426	·1103	·1108	·0858	·0852	·0591
·2364	·2377	·1847	·1842	·1418	·1425	·1103	·1108	·0857	·0852	·0591
·2363	·2376	·1847	·1842	·1418	·1422	·1103	·1105	·0856	·0852	·0590
·2362	·2375	·1842	·1842	·1418	·1422	·1103	·1102	·0856	·0851	·0590
·2362	·2369	·1842	·1841	·1417	·1419	·1102	·1102	·0856	·0850	·0589
·2362	...	·1845	·1841	·1417	·1421	·1102	·1101	·0855	·0850	·0589
·2361	...	·1845	·1841	·1417	·1420	...	·1101	...	·0850	·0587
		·1845	·1832	·1416	·1412	Mean	·1100	Mean	·0849	·0586
Mean	Mean	·1843	·1830	·1416	·1412	...	...	...	...	...
·2368	·2379	·1843	·1825	·1415	·1410	·1104	·1099	·0859	·0849	·0581
			·1820		·1410	...	·1094	...	0848	·0580
			Omitting		·1409	...	·1090	...	·0848	...
		Mean	last four	Mean	·1408		Omitting			Omitting
		·18475	Mean	·14205	·1408		last 2		Mean	last 2
			·1846		·1408		Mean		·0853	Mean
					Mean		·1108			·0592
					Omitting					
					last 8					
					·1429					

THE DISCHARGE OF A SINGLE NERVE CELL.

By Prof. Gotch, F.R.S., and G. J. Burch, M.A., Oxon.

Abstract of Paper read before Section I of the British Association at Liverpool, September 18th, 1896.

The electrical organ of Malapterurus electricus is innervated on each side by the axis cylinder branches of a single nerve cell. The response of the organ to stimulation presents characteristics, which can only be explained on the assumption that it is the change in the nerve endings of these axis cylinder branches. In consequence of these two facts, the time relations of the organ response to reflex stimulation, afford grounds for deductions as to those of the single nerve cell discharge by which the response is evoked. These time relations may be divided into two classes: (1) The propagation time through the cell and its connections, *i.e.*, central delay; (2) the periodicity of the excitatory changes issuing from the cell, *i.e.*, reflex rhythm.

1. Experiments show with regard to the central delay, that it has a minimum of ·01″. The delay is, in the opinion of the authors, due to the character of the structural path which, in the central mechanism, consists of (*a*) fine axis cylinder branches of both afferent nerves and cell processes; (*b*) an unknown field of conjunction; (*c*) the body of the nerve cell.

In the efferent nerve branches a delay of ·003″ exists both in muscles and in electrical organs, which is termed the nerve ending excitatory delay. If such delay, due to retarded propagation, is present in the central fine nerve endings, then ·006″ of the total time would be accounted for; the remaining time would then be distributed over the other structures.

2. The rhythm of the electrical reflex responses is a slow one in Malapterurus with a maximal rate of 12 per 1″. Superimposed on this rhythm is a rapid peripheral organ rhythm due to self-excitation, and in no way due to central nervous discharge.

The rate of 12 per 1″ is not often met with, and a series of this type has very few members, at most 2 or 3. The most frequent rate is one of 4 per second.

The number of members of even this slower type is limited to from 2 to 6.

The experiments thus show that the single nerve cell discharge can occur at 12 per 1″, but that it generally occurs at slower intervals, and in all cases rapidly fails.

The contrast offered by these results to those of Torpedo, in which the central rhythm varies from 100 to 30 per 1″, suggests that the latter owes its rapid periodicity to the large number of nerve cells which innervate the Torpedo organ, and which are thrown into successive activity.

THE INTERNATIONAL SUBMARINE TELEGRAPH MEMORIAL.

The following correspondence has appeared in the *Morning Post*:—

Sir,—I have read the paragraphs in the newspapers headed "Three Cable Pioneers—Arrangements for Memorial." They give an account of a meeting held at Winchester House a day or two ago, Lord Selborne presiding, to inaugurate a submarine telegraph memorial in honour of three men, viz, Mr. Cyrus Field, to whom the chairman said belonged the first application of the submarine telegraphic idea; Sir John Pender, who risked his capital and put his great force of character and energy into the promotion of it; and, lastly, Sir James Anderson, who was the captain of the *Great Eastern*, and rendered such great service to the cause. It was stated at the meeting that the scheme had received the encouragement of her Majesty, and an executive committee was appointed to carry out the idea. The names which should have stood at the head of the list, viz., Messrs. John and Jacob Brett, do not appear from the reports to have been even mentioned. In the year 1845 Mr. Jacob Brett first conceived the idea of the submarine telegraph cable, and on June 16th, 1845, he registered the General Oceanic Telegraph Company, having for its object to form a connecting mode of communication by telegraphic means from the British Islands and across the Atlantic Ocean to Nova Scotia and the Canadas, the Colonies, and Continental Kingdoms. In the year 1847 a concession was granted to Mr. Brett to lay a submarine line between England and France. This lapsed. In the year 1849 a second concession for 10 years was again granted to Mr. Brett for the same purpose. In 1850 Mr. Brett laid a copper wire covered with gutta-percha about half an inch in diameter from Dover to Cape Grisnez, near Calais. A few complimentary messages were sent through the line, but on the following morning it was discovered that the communication was broken, it having been cut by some fishermen on the French coast. The *Times* newspaper, August, 1851, published the following comment the day after the laying of this line:—"The introduction of electric communication is but of the other day. We had scarcely taught ourselves to acquiesce in the idea that instantaneous communication between two points on solid land was a mere matter of course, than it was gravely proposed to drop the communicating line and transmit intelligence along the bottom of the ocean. The jest or scheme of yesterday has become the fact of to-day. The wildest exaggeration of an Arabian tale has been outdone by the simple achievement of modern times." The feasibility of the scheme having been thus proved, Mr. Brett applied to different eminent engineers in England and France to aid in the matter, but they all declared it to be an impossibility. A company was formed, and the public were asked to find capital. Only a very trifling amount was offered, and the company fell through, notwithstanding the success of the experimental line. Mr. Brett then applied to Thomas Russell Crampton, C.E., for his advice and assistance, and he undertook to use his best exertions to manufacture and lay down a cable. The money was found by Mr. Jacob Brett, Mr. John Brett, Mr. T. R. Crampton, and four or five personal friends, and on September 25th, 1851, a cable of four conducting wires was manufactured and laid down, under the direction of Mr. Crampton, in the Channel, from Dover to Cape Grisnez, with perfect success, and that line is still working between the two countries. In 1853, a cable of six conducting wires was then laid down by the Messrs. Brett, and others associated with them, between Dover and Ostend, and this cable is also still working between the two countries. Mr. Brett was, therefore, the person to whom belonged the first conception of the submarine telegraphic idea, and also the carrying out of the same, and not Mr. Cyrus Field. Sir John Pender took no pecuniary risk whatever in the cables first laid by the brothers Brett, which proved the feasibility of submarine telegraphic lines, and Sir John Pender did not, it appears, join the Atlantic Cable Company till the year 1857, six years after the Messrs. Brett had established the submarine telegraphic communication between England and France. Mr. Brett was one of the directors of the Atlantic Telegraph Company, and subscribed a considerable amount to the capital of the company. Sir James Anderson did command the *Great Eastern* which had the Atlantic cable on board; Mr. E. B. Bright was the engineer to the company, but the credit of laying the same is certainly principally due to Sir Samuel Canning, who was knighted in consequence of his important share in the transaction.

October 12th. X. Y. Z.

Sir,—Your correspondent "X. Y. Z." brings forward the claims of the late John Watkins Brett and of his brother, Mr. Jacob Brett, with regard to the above. The Messrs. Brett are usually accredited with the first device for a complete submarine telegraph cable, but "X. Y. Z." should know that the word cable does not occur in the title of the memorial as it at present stands.

Your correspondent says:—"Mr. Brett laid a copper wire covered with gutta percha about half an inch in diameter from Dover to Cape Grisnez, near Calais." I would point out, however, that Mr. C. J. Woollaston was the engineer actually. This was preceded the year before by the experiment of Mr. C. V. Walker, F.R.S. A reference is then made by "X. Y. Z." to the useful work of the late Thomas Russell Crampton with regard to the Channel cable of 1851—a type which is practically adhered to in the present day, and was the result of suggestions from various wire-rope makers and electricians. If, however, we are to be taken back to these times in search for the inception of submarine telegraphy—quite irrespective of the amount of capital involved, of depth of submergence, and of the length of line—it becomes necessary to retrace our steps much further. We must, in fact, bark back to at least 1838. In that year General Sir F. C. Pasley, R.E. laid a line in the Medway, near Chatham. This is the earliest record of practical telegraphy under water of which any reliable details are to hand, and was followed by the line of Dr. O'Shaughnessy (afterwards Sir W. Brooke) across the River Hugli. Previously, Schilling, in 1812, is said to have laid insulated electric conductors across the River Neva and elsewhere for the purpose of exploding mines. Moreover, Sœmmering is stated to have done the same thing earlier; and Salvá suggested the possibility of submarine telegraphy as long ago as 1795. Again, we have the experimental performances of Werner von Siemens, of Morse, and of Charles West all prior to the date fixed by your correspondent.

It may be truly said that the above work was not of as important a character as the Channel cables. Still, if the latter are to be spoken of in the same breath technically and commercially with an Atlantic cable, so also must the still earlier subaqueous experimental lines.

Your correspondent rightly points out that the late John Watkins Brett took a considerable share in the promotion of the first Atlantic Telegraph Company. The rest of his remarks anent early Atlantic telegraph matters are somewhat inaccurate; but are best replied to independently by others.

No doubt the excellent suggestion of Sir Henry Mance, C.I.E., at the meeting on the 6th inst., will receive all the attention it deserves from the Committee. Sir H. Mance reminded us that Mr. Jacob Brett was still living, though not under circumstances that could be wished for considering his early work (with the late John Brett) in submarine telegraphy.

Charles Bright.

Sir,—I have just read a letter signed "X. Y. Z." in your issue of to-day, which, in its concluding remarks, does a grave injustice to the late Sir Charles Tilston Bright, and which, therefore, I feel it my duty to correct. Speaking of the early Atlantic cables, your correspondent says:—"Mr. E. B. Bright was the engineer to the company, but the credit is certainly principally due to Sir Samuel Canning, who was knighted in consequence of his important share in the transaction." The facts are, however, that Mr. Charles Bright was in complete command as engineer-in-chief of the first Atlantic line and that for the successful laying of this he—and he alone—received the honour of knighthood. It was my pleasure to act as chief assistant to Sir Charles in the expeditions connected with this line. Besides being engineer to the first Atlantic cable, Sir Charles Bright was also one of its four "projectors." I am not often tempted to encroach on the correspondence columns of newspapers, but whilst writing I would draw attention to a fact which seems to have been, to a great extent, lost sight of—*i.e.*, that actually as much as 76 per cent. of the shares in the original Atlantic Company were taken up by shareholders of the Magnetic Telegraph Company, due principally to the influence of Charles and Edward Bright. This, be it remembered, at a time when no experience had been gained as regards any great continuous length of cable being laid in deep water. The other projectors were Cyrus Field, J. W. Brett, and Wildman Whitehouse.

October 13th. Samuel Canning.

The following additional correspondence has also appeared in the *Times*:—

Sir,—Questions having been raised as to the propriety of including other names, in addition to those of Sir John Pender, Sir James Anderson, and Mr. Cyrus Field, in connection with the international submarine telegraph memorial, I am authorised to say it has always been intended that the whole subject should be fully considered by the executive committee at its first meeting, fixed, I may mention, for the end of the month, to suit the convenience of Lord Kelvin.

Geo. R. Neilson, *Hon. Secretary.*

188, Winchester House, Old Broad Street,
London, E.C., *October 14th.*

Sir,—The most important question at the present moment in connection with the proposed submarine telegraph memorial appears to be that of whose names shall be, and whose shall not be, associated with it. Those correspondents who, through the medium of your columns, have suggested the names of several eminent electricians as being worthy of that distinction, have singularly overlooked the name of an engineer which, above all others, should, to my mind, be associated with the movement, if any are. I refer to Thomas Russell Crampton, who died in 1888, and who, in 1851, succeeded under exceptionally difficult circumstances, in laying the first successful cable for a submarine telegraph between Dover and Calais. He undertook the entire engineering responsibility in this first practical step in submarine telegraphy, from which sprang the magnificent system of intercommunication now common to the world. I think Mr. Crampton may therefore fairly be regarded as the father of practical submarine telegraphy.

But, in my opinion, by associating with the movement the names, however honourable, of those who were connected either scientifically or commercially with the establishment of submarine telegraphy, an injustice would be done to others by whom submarine telegraphy was rendered possible. I refer to those to whom the inception of electrical telegraphy and its subsequent development into practical shape is due. The subject stretches a long way back into the past, but the honoured names of Cooke and Wheatstone stand forth most prominently in this connection. They, however, only took up and perfected the work of their predecessors. At least a score of names adorn the roll of fame in this respect, and, commencing a century ago with those of Galvani and Volta, we have further inscribed on it those of Sömmering, Schweigger, Coxe, Romagnósi, Oerstedt, Ampère, La Place, Fechner, Alexander, Sturgeon, von Cannstedt, Faraday, Morse, Gauss, Weber, and Steinheil, each of whom contributed a round in the ladder which was ascended by Cooke and Wheatstone. Whilst as a matter of fairness these names, and even others, should not be excluded if any are admitted, it would, of course, be most

inexpedient to engraft on the memorial such a list, however brilliant. To my mind, the only course is to exclude all personal references, and to let the merits of the magnificent system which the memorial is intended to commemorate be the foundation upon which it is reared.

PERRY F. NURSEY.

Mitre Court Chambers, Fleet Street, London,
October 13*th*.

Sir,—After reading Lord Selborne's address to the committee, I am not surprised that your attention is called to the suggestion of the names of Mr. Cyrus W. Field, Sir John Pender, and Sir James Anderson to represent one of the scientific triumphs of the age; and as I was in telegraphs in 1852, and joined the Atlantic Company when it was formed in 1856, would you permit me to confirm the letters of Captain Moriarty and Mr. Clifford, and to state further that the inception of the Atlantic telegraph was due to Cyrus W. Field, John Watkins Brett, E. Wildman Whitehouse, and Charles T. Bright; the two former being the business men, Mr. Whitehouse the electrician, and Mr. Bright the engineer-in-chief; and in a deed of agreement with the company they are there described and were always known as "the promoters"? The two former largely raised the money, assisted by Mr. Bright, who was engineer to the Magnetic Telegraph Company, and by Mr. John Pender, who was a director of the British Telegraph Company and became one of the directors of the Atlantic Telegraph Company. Associated with Mr. Bright as engineers were Mr. Samuel Canning, Mr. Henry Clifford, and Mr. Webb; and with Mr. Whitehouse as electricians were Mr. C. V. de Sauty (then electrician to Glass, Elliot & Co.), Mr. J. C. Laws, and Mr. Henry Saunders. As the navigator Captain Henry Moriarty was lent by the Admiralty. These were the men who attempted the 1857 and laid the 1858 cable. When the 1865 cable came to be laid Sir Samuel Canning was engineer-in-chief, and Mr. Henry Clifford was next to him. Messrs. C. V. de Sauty and Willoughby Smith were electricians to the contractors, the Telegraph Construction and Maintenance Company, Mr. Cyrus Field and Prof. Thomson (now Lord Kelvin) representing the Atlantic Telegraph Company, the latter as electrician.

Captain Sir James Anderson was appointed as commander of the *Great Eastern* late in June, 1865, and when he joined the ship everything was arranged by the engineers and electricians, and he had simply to handle the ship, Captain Robert C. Halpin being chief officer. Captain Moriarty was again the navigator. We failed to lay the whole cable that year, and in 1866—after the formation of the Anglo-American Company—there was very nearly the same scientific staff on board, and that staff laid the 1866 and grappled for and successfully completed the 1865 cable, which latter work, I consider, was the greatest work in submarine telegraphy.

Sir Richard Glass, the managing director, and Sir George Elliot, a director of the Telegraph Construction Company, with all their colleagues, including Sir Daniel Gooch and Sir Thomas Brassey, as well as the directors of the Anglo-American Cable Company, found, equally with Sir John Pender, princely sums in furtherance of submarine telegraphs, and it does therefore appear more than singular if the only names so distinctly associated with submarine telegraphs should be those given by Lord Selborne; and I venture to think, if you will give the aid of your columns, it will result in at least adding some of these able and scientific men, who gave their brains with a devotion which deserves this recognition without in any way detracting from the services rendered by Messrs. Pender, Anderson, and Field.

JNO. TEMPLE, one of the Assistant Engineers for five Atlantic Telegraph Cables.

Liverpool, *October*.

Sir,—Whilst dwelling on the great work done in 1851 by the late Mr. T. R. Crampton, Mr. Perry F. Nursey suggests that "he may be regarded as the father of practical submarine telegraphy." In my opinion, however, no single individual can be justly spoken of in that light, as it is a work which has been gradually built up in different directions by many hands. It would, perhaps, be more to the point to refer to Salva (1795) as the father of the idea of submarine telegraphy, and to Pasley (1838) as the first to devise and lay an insulated telegraph line under water with good effect. Between these periods Sömmering and Schilling (1812) are said to have exploded mines by subaqueous electric conductors by their own design and arrangements.

Mr. Nursey hints that all the early *savants* of electricity and magnetism, such as, in the first instance, rendered electro-telegraphy possible, should be memorialised on this occasion. That would, of course, lead us into a very wide field—perhaps, more suggestive of electricity or electro-telegraphy, in its broadest sense, than of the present subject of the memorial.

With the last sentence of Mr. Nursey's letter all will, no doubt, agree.

In his list of assistant engineers engaged on the first Atlantic cable expeditions of 1857 and 1858, Mr. John Temple might have added the names of the late Mr. W. H. Woodhouse and Mr. W. E. Everett, U.S.N., as having both taken a prominent part on her Majesty's ship *Agamemnon* and U.S.N. ship *Niagara*, the two ships sent out by their respective Governments for the purpose.

CHARLES BRIGHT.

October 15*th*.

The *St. James's Gazette*, of 21st inst., says:—

The propriety of the proposed memorial to the late Sir John Pender, Sir James Anderson, and Mr. Cyrus Field, as representatives of the Inception and Extension of Submarine Telegraphy, has been very properly called in question by Captain Moriarty, R.N., C.B., and others. It would appear to be somewhat greedy on the part of the monied men to attempt to lay claim to honour which is certainly—for what little it is worth—rather due to the men of science. To take a notable example, if, as has been suggested, Sir James Anderson laid the early Atlantic cables, we should like to know where Sir Charles Bright and Sir Samuel Canning come in! To be more accurate, the late Sir C. Bright was alone responsible for the laying of the first Atlantic cable from H.M.S. *Agamemnon* and U.S.N.S. *Niagara*; and he was always known as the first telegraph knight, receiving that honour (as this week's *World* points out) at the early age of 26, for his great work. On the expeditions of 1865 and 1866, Sir Charles being engaged elsewhere, he was succeeded as engineer-in-chief by Sir S. Canning (his former assistant) from whom Sir J. Anderson, Captain of the *Great Eastern*, took orders—according to general custom on telegraph ships.

Truth, of October 22nd, says:—

With reference to the proposed memorial to the late Sir John Pender, the secretary has written a letter to the *Times* asserting that it has been all along intended that the whole question of names should be gone into at the first meeting of the Executive Committee. If that is so, how came the official note paper to bear the following words?—

Object:—To commemorate the inception and extension of submarine telegraphy, associated with the names of Sir John Pender, Sir James Anderson, and Mr. Cyrus Field.

People's intentions must be judged by their actions and language. It may be true that the present intention is as stated by the secretary; but in view of the above words it is difficult to believe that this has been the intention from the first.

The *World* for August 21st says:—

I hear there is a good deal of dissension regarding the proposed commemoration of the "inception and extension of submarine telegraphy." The project is the outcome of a suggestion to establish some fitting memorial to the late Sir John Pender, and it is perhaps a pity that the original scheme was not adhered to. It cannot be admitted that the names of Pender, Anderson and Field are typical of the new title of the memorial. The idea of submarine telegraphy must have been conceived before Sir John Pender, Sir James Anderson, or Mr. Cyrus Field was born, and its realisation is certainly due in the first instance to various scientific engineers and electricians.

Among such electrical scientists who are no more are Sir Charles Bright, Dr. Werner Siemens, Mr. Willoughby Smith, and Mr. C. F. Varley; while on the business side of the matter, besides the names already mentioned, are those of the late Mr. Thomas Brassey, Mr. John Watkins Brett, Sir James Carmichael, Sir Daniel Gooch, Sir Richard Glass, and Sir George Elliot—the three latter largely concerned with the late Sir John Pender in the promotion of the Telegraph Construction and Maintenance Company, which has since manufactured and laid so many of our cables, and the two former in the Channel cables of the old Submarine Telegraph Company. Moreover, Mr. John Watkins Brett and Sir Charles Bright equally shared with Mr. Cyrus Field the distinction of being the "projectors" of the first Atlantic cable, the last named, also, having been its engineer, and having been knighted for his services at the early age of 26.

CORRESPONDENCE.

Alternate Current Station Switch Gear.

In your issue of the 16th Mr. Kenny inquires if it would not be possible to replace the differentially-wound shunt coil of our return current cut-outs by a spring, and a winding on only one end of the coils. But he does not say how he proposes to connect the shunt winding relatively to the series. If he means to simply do away with the bottom half of the shunt winding, and leave the top half connected up as we use it, the arrangement certainly would not work, but a somewhat similar arrangement can be made to work by connecting the shunt winding at the top, so that under working conditions the current in the shunt winding flows in the same direction as that in the series. This will lift the core when the current reverses, because a large current flowing in an opposite direction to the shunt will, by mutual induction, increase its power and cause it to lift the core.

This is one of a great variety of arrangements of compound windings I have worked out in my endeavours to design a reliable return current cut-out; but the differential winding described is the only one that works perfectly under all conditions.

Our outer conductors are only earthed at one point, consequently all the current from any machine is bound to pass through the series winding of the cut-out coil.

I take it that the E (fig. 1 in the article referred to) which seems to have puzzled Mr. Kenny is simply intended to show that this terminal of the armature is kept at earth potential.

With reference to Mr. Blackie's letter, I cannot understand why my having stated that at one time we only had

one switchboard attendant we could rely upon to switch machines into parallel should reflect discredit on the Hastings staff.

Possibly Mr. Blackie's ideas of synchronising and my own do not quite correspond. We have always had several men who could switch a machine on to the bus bars, but their doing so generally produced a decided jump in the lights, consequently we did not rely upon them to do it often. But with the cut-outs we now use we not only allow anyone at the works to synchronise, but also should have no hesitation in letting either "The Young Synchroniser" or the poet who so adequately described his feelings, to do so, as nothing they could do would seriously affect the lights. The attendant who has been using the apparatus for the past two months can synchronise fifty times in an hour, and keep the lights steady through it all.

To get a machine out of parallel, we now always close the stop valve of the engine, and allow it to cut itself out.

L. Andrews.

"Electric Light Fittings: Their Electrical and Mechanical Design."

Referring to your last issue, I had no intention of providing "copy" for an advertisement or testimonial, in writing the above article.

Those who seem to have jumped to this conclusion, and have used my criticism to their own advantage, should call to mind the lines:—

> Oh wad some power the giftie gie us,
> To see ourselves as others see us.

The Writer of the Article.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week Ending Oct. 20th, 1895.	£	s.
Aden	75	0
Algoa Bay	256	0
Amsterdam	250	0
Antwerp. Blasting cable	15	0
Auckland	50	0
Azores	30	0
Bilbao	19	0
Boca	118	0
Bombay	17	0
Brussels	82	0
Buenos Ayres	266	0
Calcutta	44	0
Cape Town	446	0
Colombo...	21	0
Delagoa Bay	2,187	0
East London	196	0
Monte Video	90	0
Melbourne	271	0
" Teleg. mtl.	195	0
Pernambuco. Teleg. mtl.	1,494	0
Penang. " "	350	0
Port Natal	13	0
Pirie	340	0
Shanghai	228	0
Stockholm	120	0
Total	£7,173	0

Week Ending Oct. 20th, 1896.	£	s.
Adelaide	15	0
Alexandria	18	0
" Teleph. mtl.	122	0
Amsterdam	50	0
Bombay	31	0
Buenos Ayres	365	0
" Teleph. mtl.	15	0
Calcutta	47	0
Cape Town	282	0
Christiania. Teleg. mtl.	50	0
Christchurch	16	0
Colombo...	106	0
" Teleg. mtl. ...	62	0
Durban	44	0
East London	1,539	0
Flushing	45	0
Gothenburg. Teleg. mtl.	67	0
Halifax. "	8,257	0
Hong Kong. Teleph. mtl.	55	0
Launceston	116	0
Melbourne	132	0
" Teleg. mtl.	201	0
Monte Video	141	0
Montreal	25	0
Passages	83	0
Perth	525	0
" Teleg. mtl. ...	98	0
Port Elizabeth	1,069	0
Rangoon	29	0
Rotterdam	11	0
St. Petersburg	75	0
Saigon	20	0
Shanghai. Teleph. mtl.	69	0
Sydney	188	0
" Teleph. mtl. ...	140	0
Stockholm. Teleph. mtl.	92	0
Teneriffe " "	120	0
Yokohama	240	0
Total	£14,560	0

Auction Sale.—We give in our "Official Notices" particulars of electrical plant, lathes, drilling and shaping machines, oil engines, &c., which will be offered for sale by auction on November 3rd, by Messrs. Protheroe & Morris, at 89, Worship Street, E.C., by order of Mr. L. C. H. Mensing.

Ambroin.—We understand that Mr. Oscar Schölzig, of Dashwood House, E.C., is the London agent representing the Berlin manufacturers of ambroin, the new insulating material to which we referred last week.

Bankruptcy Proceedings.—(The affairs of Paterson and Cooper.)—At a sitting of the London Bankruptcy Court, held last Friday before Mr. Registrar Brougham, Edward James Paterson and Charles Friend Cooper attended for public examination. The debtors traded as electrical engineers and contractors, under the style of Paterson & Cooper, at Prince's Mansions, Victoria Street, Westminster; 137, West Regent Street, Glasgow; and the European Works, Pownall Road, Dalston. The accounts filed under the proceedings show gross liabilities, £19,514 6s. 3d., of which £9,643 19s. 10d. are expected to rank, against assets valued at £16,665 2s. 5d., sufficient to provide a surplus of £7,000, after payment of all liabilities. Mr. Paterson was first examined by the Assistant Receiver (Mr. G. W. Chapman), and stated that he had been in business as an electrical engineer since 1878. Mr. Cooper joined him in 1882, paying £1,500 for one-fourth share, and introducing £4,500 to the capital account, which was thereby increased to £18,000, as witness at the time had £13,500 to his credit. Various loans, amounting in all to £6,600, were subsequently introduced by them, and after some changes, they eventually became equal partners. In addition to their business as electrical engineers and contractors, they had also since 1886 been interested in certain patented processes for bleaching and disinfecting by electrolysis, of which patented processes Mr. Hermite, of Paris, was the inventor. They purchased a half-share of the patents, and during the 10 years had worked continuously upon them, with the result that they were now over £12,000 out of pocket. Patents had been taken out in nearly every country, and the cost of renewing them, which had been borne by witness and his partner, formed a first charge on the profits. A limited company had been formed recently to take over the English rights, and those of all other countries except France and Belgium, and the French and Belgic patents had been sold to a French company, promoted to acquire them. Although witness and his partner estimated they were £12,000, so far, out of pocket over the patents, they expected to recover a good portion of the amount, as the patents possessed considerable value. They attributed their appearance at the Court to the withdrawal of capital from the business for the purpose of the patents, to delay in floating the English company, and to heavy law costs and interest charged on borrowed money. Their accounts showed a large surplus, but their solvency depended entirely upon the value of the patents. Negotiations were still pending for their sale, and if they were to obtain a fair price, their statement of accounts would be substantiated. Mr. Cooper corroborated the evidence given by his partner, and both debtors were allowed to pass.

Dissolution of Partnership.—Messrs. Harry Thorpe and Harold Waring, formerly carrying on business as mechanical and electrical engineers at Theobald's Road and Eagle Street, W.C., as Thorpe & Waring, have dissolved partnership by mutual consent. Mr. Thorpe will attend to debts.

Catalogues.—Mr. Archibald J. Wright, of 70, Farringdon Road, E.C., has just issued an illustrated price list of electric bells, indicators, batteries, pushes, and general accessories.

Messrs. Rumsey & Co., Limited, of New York and Seneca Falls, have sent us an illustrated catalogue of power pumps and hydraulic and pumping machinery for all purposes. A number of the machines shown are driven by electric motors, particularly Rumsey's triplex power pump.

Change of Address.—Messrs. Mavor & Coulson have removed to 47, King Street, Bridgeton, Glasgow.

Clarke, Chapman & Co.'s Extensions.—The old engineering works of Messrs. Black, Hawthorn & Co., Gateshead, have been acquired by Messrs. Clarke, Chapman & Co., Limited, of the same town.

Extension of Works.—The Consolidated Telephone Construction and Manufacturing Company, Limited, announce that they are extending their works at Coventry, finding that although they are much more commodious than the old shops at Farringdon Road, they are insufficient for the work now in hand.

For Sale by Private Treaty.—The trustee of the estate of Messrs. Paterson & Cooper, in bankruptcy (Mr. Edward Cecil Moore, of 3, Crosby Square, E.C.), is prepared to receive tenders for (1) the purchase of the goodwill, fixtures, fittings, and furniture, as a going concern, of the old-established electrical contracting business hitherto carried on at No. 3, Prince's Mansions, Victoria Street, S.W.; (2) the goodwill, furniture, &c., as a going concern, of the contracting business carried on by the firm at Glasgow; (3) the goodwill, &c., of the measuring instrument department; (4) the goodwill of the dynamo department. Further particulars may be obtained from Mr. Moore at the above address.

Gas.—Three persons were injured, and premises at Bellmore Street, Battersea, were wrecked by a gas explosion which occurred on 15th inst.

A chemist's premises in Gray's Inn Road were badly damaged by gas explosion and fire on 16th inst. An escape was sought for with a light. We wonder when people will learn what a sure method of causing an explosion is this insane way of detecting a leak.

On 19th inst. an explosion of gas set fire to some shop premises in Tudhoe Grange, Spennymoor.

On Tuesday a gas explosion at the "Stag and Hounds," at South Croydon, shattered several rooms and injured the landlord.

Kempston Electric Lamp Works.—These works, which about 12 months ago were taken in hand by the Crystal Electric Lamp Company, of Telegraph Street, London, are now in full swing for the manufacture of incandescent lamps and fittings. Engines and boilers of 100 H.P., continuous current dynamos, alternators, vacuum and air pumps, and the other necessary plant has been put down, and 20 men and 30 girls are now engaged in the various departments making incandescent lamps. They are under the direction of Mr. Harrison, who is assisted by Mr. Pickering. From an account appearing in the *Bedfordshire Times* it appears that the convenience of the staff is well studied.

The Jandus Lamp.—The Jandus Arc Lamp and Electric Company, Limited, has issued a list giving full particulars of this lamp, and a number of good photographs showing premises where the lamps are used.

"Trafalgar."—With the *Shipping World* Trafalgar Day issue is presented a photo engraving of a fine monotone drawing by Mr. Quiller Lane, "Trafalgar Day at Noon," illustrating Nelson's ship *Victory* at the head of the division raking the French flagship *Bucentaure*.

W. & R. United.—We are occasionally reminded by correspondents in the financial papers that the winding-up operations of the memorable Woodhouse and Rawson United, Limited, have not yet been completed. "Debenture Holder" now writes to the *Financial Times*:—"In March, 1893, a circular was issued to the debenture holders of Woodhouse & Rawson United, Limited, by Mr. T. D. Leslie, stating that he had been appointed by the High Court of Justice receiver and manager of the company. Up to the present time the debenture holders are still without any return of the money, and also without any balance-sheet. The winding-up order was made on May 17th, 1893. Can any of your readers give any information as to the position of affairs? It would seem as if the liquidation of this concern was to last until the judgment day."

Wire-Bound Hose.—Messrs. W. H. Wilcox & Co. have taken the works lately occupied by the Sphincter Grip Company, in London, to manufacture their patent wire-bound hose. Formerly all the work had to be carried out in Dublin. We understand that the construction of this wire-bound hose is entirely different to the ordinary rubber, being manufactured from the finest flax linen, which is oil dressed, and being bound by wire on the outside, also internally, the structure is one of the strongest that could be possibly introduced for hose, and, at the same time, it does not interfere with it being flexible.

X Rays.—We have received a copy of a list published by the General Electric Company of electrical apparatus for the X ray photography. Prices and particulars are given of the Rhumkorff coils, primary and secondary batteries, focus tubes and stands for same, besides fluorescent screens, and a number of complete outfits which the company has made up; among them are some of the most improved patterns, such as have been suggested by medical and scientific authorities. There is a detailed table regarding the battery to be used with the coils. To every purchaser is given a copy of detailed instructions, with illustrations, which have been compiled by the company.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The Watching and Lighting Committee is to hold a special meeting to consider the whole question of electric lighting of the streets.

Bath.—At a meeting of the Bath Urban Sanitary Authority, held on Tuesday, Mr. Alderman Sturges, the chairman of the Electric Lighting Committee, brought up a recommendation that the previously sanctioned application to the Local Government Board for permission to borrow £45,000 for electric lighting purposes should be increased to £50,000, the main necessity for the increase being a desire on the part of the committee to provide sufficient capital for a much larger extension of the mains than that contemplated in the original scheme. Mr. Robert Hammond, the consulting engineer of the Corporation, was present, and was called upon to explain the details of the scheme, and after a somewhat warm debate, the resolution was carried by 23 votes to seven. The Local Government Board inquiry is fixed for 30th inst.

Barnes and Mortlake.—The Finance and General Purposes Committee reports that representatives from the County of London and Brush Provincial Electric Lighting Company attended before them respecting the Council consenting to a provisional order in the company's favour for this district. Consideration was adjourned until November 6th.

Battersea.—The electric lighting provisional order has received Royal assent.

Bingley.—The chairman of the Gas Committee is to interview Mr. Harris with respect to the proposal of the Leeds and Liverpool Canal Company to supply this district with electricity, and to obtain information as to the cost of distribution.

Bradford.—The Council has taken 204, Swan Arcade, where electrical appliances will be exhibited in order to encourage the use of electricity for lighting and motive power purposes.

We hear that it has been decided to supply electric incandescent lamps to all users free of cost, the conditions being that such lamps should burn for 1,000 hours, or have used 60 units during their life. This is equivalent to a reduction of about a farthing per Board of Trade unit. It was also decided to institute a system of lending motors on hire.

Bragado.—The tenders sent in to the Municipality for the supply of an electric light plant for the town were as follows:—

	Gold.	Paper.
Kexel & Co.	$18,092.10	$6,000
Masson & Co.	15,500.00	...
Ulises B. Barbieri... ...	19,474.00	7,400
Charles Bright	9,460.70	750

The *Review* of the River Plate says that the latter tender does not include the erection, which it is proposed to do at cost, with 15 per cent. for superintendence.

Brighton.—We understand that the work of extension at the Brighton Corporation Electricity Works, which has been in progress for some time, is now nearing completion. The additions at the rear include a boiler house, engine room, stokery and store rooms, also mess rooms and offices for the overlookers of the various departments.

Burton.—A committee says that the necessary mains should be laid down Union Street to the Infirmary in Duke Street, for the purpose of supplying the Free Library and the Infirmary with the electric light.

Chester.—The Council has resolved to have the public market and annexe and the Town Hall wired and fitted for electric lighting, under the supervision of Prof. Kennedy and the City Surveyor. The tenders sent in for lighting the Town Hall ranged from £473 to £772. The Free Library is also to be lighted.

Croydon.—The Electric Lighting Sub-Committee recently reported that the British Thomson-Houston Company, Limited, had requested to be allowed to substitute the security of the Comptoir National d'Escompte de Paris in lieu of the guarantee fund as provided for in the contract. The Town Council has agreed to this course subject to the execution of a bond to be approved of by the town clerk, the present moneys in the guarantee fund to be paid to the contractor less a retention of 10 per cent.

Dingwall.—The Council conferred with Mr. R. F. Yorke, electrical engineer, a few days ago, regarding the proposal to light the burgh electrically. Two schemes were discussed: the first to erect works on a river in the vicinity of Achlaun, and convey by wire the current over the intermediate hills, about three miles to the town; the second, to act in company with the people of Strathpeffer, utilise the Peffery as a source of power by impounding dams or otherwise, and supply both burgh and village with the light. No decision was arrived at.

Douglas (I. O. M.).—Some days ago Mr. S. V. Clirehugh attended before a committee, and went at length into the subject of electric lighting. It is understood that the committee will recommend the Council to engage Mr. Clirehugh to report fully on a scheme.

Mr. G. Gilmour, a local ratepayer and electrician, has written to the Lighting Committee, giving them gratis some important and necessary hints in regard to electric lighting. We make the following extracts from his letter:—"A rough idea of what power would be required to light Douglas can be got from the following:—It takes about 1½ horse-power to light each 2,000 candle-power arc lamp, such as are in use in the main streets across the water. These lamps are placed from 80 to 100 yards apart. It takes about the tenth of a horse-power to light a 16-candle-power incandescent lamp, which is about equal to an ordinary gas burner in good order. It will cost property owners about £1 per light to fit up their property for the new light. If, after considering the matter carefully, it is decided to have the electric light, I would say—1. Get the best consulting electrician you can get hold of; it is cheapest in the end. Let him advise you. Have nothing to do with men having an interest in any one firm. 2. Let there be no half measures in the way of sites, &c. Let a good site be obtained, and one that will allow of extensions to meet the future requirements—for there will be no going back. If the matter is taken up, the light must be supplied to those who want it, even if they give it up again. 3. Let the mains and ways for the wires be made large enough for the future, although a few wires only may be run in them at first. Small sites and small culverts have led to more trouble than is generally known." This letter has been referred to the Town Clerk to take into consideration in connection with the report now being prepared by him in relation to electric lighting.

Dover.—An order has been given for nine arc lamp columns for Biggin and Cannon Streets.

Dublin.—The Electric Light Committee paid a visit, last week, to Pigeon House Fort, which it considers an excellent site for the new electric lighting station.

Exeter.—At a meeting of the City Council last week, the Electric Lighting Committee reported that the Brush Electrical Engineering Company had placed them in a difficulty at the electric light works, in consequence of the non-delivery of goods ordered, and that two transformers had been obtained elsewhere. A hope was expressed that an all-night supply would be available shortly.

Glasgow.—At the end of last week the electric lanterns in Charing Cross were not used, in order that they might be replaced with the more graceful overhanging arm. Eight of the pillars are being altered.

Grimsby.—Too much has been expected of the old dynamo which supplies the lamps at the Town Hall. The surveyor and others declared that it would not safely carry more than 160 lights, yet it was sometimes necessary to have as many as 250 lamps. A new dynamo is therefore to be purchased, a committee is to consider what its capacity, &c., shall be, an expert is to examine the old machine, and in the mean time the supply to the Town Hall is to be kept as low as possible, preference being given to the Council Chamber and the Assembly Room.

The Public Lighting Committee has been discussing what to do about the provisional order, the date for which has now expired. It was decided to let the matter lay in abeyance for 12 months, and fight meanwhile any company that comes along. But will the Board of Trade allow this? A company has already offered to pay a little more than the cost of the order if the Council will agree.

Harrogate.—Electric light cables are to be laid over the York Place and Victoria Avenue bridges, for the North Eastern Railway Company.

India.—It has practically been decided to give Rs. 95,000 for the Darjeeling electric light installation, which is to be set up by Messrs. Kilburn & Co., and to be ready by September next year.

Inverness.—An electric light installation was inaugurated at the new Glen Mohr Distillery, Inverness, on 14th inst. Water-power taken from the Caledonian Canal, where there is a 30 feet fall, is used.

Islington.—The Vestry applied on November 1st, 1895, for the London County Council's sanction to a £25,000 electric lighting extensions loan. Up to the present it has not been received. The matter was discussed at the last Vestry meeting.

Kingswood.—The proposal to purchase the electric light installation (Parfitt system) has many times been under the Electric Light Committee's consideration, and we understand that they have again gone into the matter.

Leyton.—Various matters connected with the municipal electric lighting installation were before the District Council a few days ago. Thirty meters, at an estimated cost of £200, are to be obtained. Instructions have been given to insure the central station buildings and plant. Supply was announced to commence on 15th inst.

Lincoln.—The *London Gazette*, last Friday, contained notice of the application to be made by the Urban Sanitary Authority for an electric lighting provisional order. Particulars are given of the area proposed.

London, E.C.—The City Company's high charges to private consumers have naturally over and over again occupied the attention of the City authorities, and we suppose will continue to do so until some reduced system is introduced. We imagine, however, that the City Company, so long as the demand for a supply of current is satisfactory, will not be disposed to make any appreciable reduction. It is well that pressure should be brought to bear upon the Board regarding this, for there is considerable dissatisfaction among consumers. A reduction would bring in many new customers when they are wanted. Mr. Hitching, a member of the Court of Common Council, wants to know whether the Commission of Sewers has approached the City Company with a view to securing a reduction of the cost to private consumers, and it is probable the matter will be inquired into.

Long Eaton.—The District Council has instructed the clerk to look up the minutes as to any powers for lighting the town by the electric light.—Mr. Winfield contended that the present system of lighting the town was a disgrace to those in authority. He gave notice of a motion on the subject.

New Deer.—According to an Aberdeen paper, the Street Lighting Committee of New Deer has a proposal to introduce electricity under consideration. The practicability of utilising water power in the vicinity is also to be considered. A few electrical engineering firms are to be communicated with on the subject.

Russia.—Messrs. Naeck & Holsten, of Stralsund, have secured a contract for 1,200 arc lamps, required in connection with the electric lighting of the public streets of Kharkoff.

Sheffield.—The City Theatre is to be lighted throughout with electricity.

The new Estate Sale Rooms and Auction Mart in Church Street are lighted electrically.

Shoreditch.—The Vestry's application for the loan of £31,381 for the Pitfield Street electric light and refuse destructor premises, plant, &c., came before the London County Council on Tuesday. The Council's engineer and architect have examined the estimate of the proposed works, and the Finance Committee considered that part of these items should be deducted and the loan reduced for the present to £29,655. The Vestry ask that the whole amount may be treated as one loan and the repayment spread over 42 years; but the Committee was not disposed to recommend the Council to depart from the usual course of having regard to the life of the works in all cases except for electric lighting undertakings, and consider that the period for repayment of the buildings and plant for the dust destructor should be limited to 30 and 15 years respectively, the period of 42 years being confined to the cost of the electrical installation. The report was agreed to by the Council.

South America.—A River Plate exchange says that considerable progress is being made with the Calle Cuyo electrical station, and by this time the new 650 H.P. triple expansion engine is running. This engine, with its direct-coupled dynamo, is stated to be the largest and most modern unit of electrical power in South America.

Southampton.—Application is to be made to the Board of Trade in the ensuing session for an order authorising the Corporation to supply electricity within the added areas.

Spain.—The Sociedad Santa Ana de Bolueta proposes to establish a central electric lighting station at Bilbao.

Sunderland.—The Avenue Theatre was, on 12th inst., lighted by electricity for the first time.

Swansea.—Four tenders for the proposed electric lighting of the new market were considered by the Oxford Street Market Committee. There was practically little difference in the amount of the tenders, but the average cost was shown to be £2,000, with £400 per annum maintenance, and the cost was considered to be prohibitory. No decision was arrived at.

Swindon.—The Electric Lighting Committee, acting upon the advice of their engineer (Mr. J. G. Aldridge), visited last week the principal Corporation electric stations in the Midlands.

Walsall.—The Streets Committee reports that the question of lighting High Street by means of electric lamps had been postponed to ascertain what the additional cost would be of putting up six arc lamps instead of four, the gas manager in the meantime to report as to the extra cost of maintaining incandescent burners.

West Ham.—A question has been raised for the consideration of the Council of this district, and also for the Stratford authorities, nine Stratford firms having expressed the desire to have their premises lighted electrically from the West Ham Station. The West Ham Library buildings are to be lighted electrically.

Worcester.—The City Council had a discussion the other day regarding the unsatisfactory state of the electric light fittings at the Assembly Room; and it was suggested that the consulting engineer who had advised regarding the work should be asked for an explanation, as he had declared the contractors had left the work in a satisfactory condition. In the end, the Council accepted the tender of Messrs. H. G. Keen & Co., for removing the gas fittings from the three sun lights in the Assembly Room and wiring the same for the electric light, according to the electrical engineer's specification, for £34.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackburn.—The approaching introduction of electric tramways into this prosperous manufacturing town marks the first step towards the adoption of methods that must exercise a great influence upon municipal enterprise, for the local authority proposes not only to furnish current for operating the two electric lines from the municipal electricity works, but will also take in hand the erection of all overhead wires, poles and other structures, as well as the bonding of rails, laying of feeders, &c. The tramway company will provide its own rolling stock and motor equipments, receiving from the Corporation an extended lease of the lines. The important questions of maintenance, as regards the circuits (outgoing and return) and the rolling stock, are, however, not yet settled, being matters that fall for treatment in the agreement, now, we understand, in process of drafting between the Corporation and tramway company. Considerable interest will be felt by electric traction circles in the final arrangements made, as conditions of a similar nature have not yet arisen anywhere else; indeed, Blackburn will, for that matter, occupy the position of being the first town in the country to operate tramways from the municipal electric lighting works. Mr. J. G. W. Aldridge (with whom is Mr. Frank B. Lea, lately resident engineer on the Rouen electric tramways) is advising the tramway company, whilst Mr. E. M. Lacey acts as consulting engineer to the Blackburn Corporation.

Bray.—Messrs. Molloy & Molloy, solicitors to the promoters of this electric tramway scheme, have written a letter to the *Irish Independent* pointing out the advantages of the proposed system.

Buenos Aires.—It seems that the position of electric traction in Buenos Aires is very much the same as in this country. A River Plate contemporary commenting upon the matter, says the public would be apt to think business was getting dull if a week were to pass without a new concession for an electric tramway being applied for, and rumours have even been heard of orders given for plant; but with all this seeming activity, there is as yet nothing to show for it. "We now hear, however, that a definite move has been taken, and that a complete lot of material, including track and rolling stock equipment, is shortly expected to arrive in this country, to the order of Mr. Bright, the well-known electrical engineer and contractor, and will be in operation before the end of the year. The cars are of the most modern description, to seat 40 passengers, and are fitted with powerful electric brakes; each car has motive power enough besides to draw two loaded street cars, a great advantage on busy days. The destination to be given to this shipment will be

watched with interest, as city traffic is undoubtedly ripe for such an improvement. Mr. Bright was the first in Buenos Aires to give us electric lighting by means of underground conductors, and it would seem as if he was to be first in the field with electric traction."

Calcutta.—An Indian exchange states that Mr. Archibald A. Crawford, the agent here for the Allegemeine Electricitats Gesellschaft, of Berlin, has received the consent of the Corporation to his application to the Local Government to supply electricity to Calcutta, under Act 4 of 1895.

Earl's Court to the Mansion House.—A fortnight ago we mentioned that a scheme was on foot for laying an electric underground railway between Earl's Court and the Mansion House, with an intermediate station at Charing Cross. A *Times* writer discusses the prospects of this proposed line, and considers the scheme generally. He says that the people who would be benefited by an express service to Earl's Court would be those travelling from the City to the suburban districts lying beyond. But under the present proposal, says the writer, they will only be able to avail themselves of it upon condition of changing from the high level to the low level station, and *vice versa* at Earl's Court. "Nor indeed is it easy to see how this can be avoided. For, even assuming a gradient of 1 in 50, it would require a continuous rise of half a mile to bring up the sub-district to ground level from a depth of only 50 feet. Even then the company would, apparently, be face to face with the difficulty which has hitherto blocked all attempts at the application of electricity on the underground lines—namely, the necessity of working interchangeably steam locomotives and electric motors." Sir Benjamin Baker has the various points under consideration. Considering the financial prospects of the undertaking, the *Times* correspondent holds that "In order to pay 4 per cent. interest on the capital, the gross earnings would need to be twice £40,000, that is £80,000, or, reduced to the form in which it is commonly expressed, £16,000 per mile per annum. Now this receipt, though large, is nothing unheard of. . . . . The Metropolitan District, which includes in the 19 miles of its system a good deal of comparatively unproductive line, averages not far short of £24,000. Or, to take other instances, the Mersey Tunnel, not unlike the new Sub-District in the fact that the bulk of its line is beneath the river bed, and consequently without intermediate stations, earns £17,000 per mile per annum. The City Lines Extension, which completes the Inner Circle between Bishopsgate and the Mansion House, earns £18,000, and the City and South London £16,000. On the other hand the Liverpool Overhead, which, it is fair to say, is too new to have yet reached its full development, only earns about £10,000. On the whole it is evident that £16,000 per mile per annum, though by no means unattainable, means a pretty heavy traffic. . . . . On the whole 20 million passengers per annum seems a good many to reckon on, and if the Central London, when opened, does as has been suggested, and charges a *maximum* fare of 2d. and 3d. from the Uxbridge Road to the Bank, the Sub-District is hardly likely to be able to maintain a scale of 1d. per mile. There is another matter of some importance to be considered, and that is where the passengers for the new line will come from. In the first instance, at least, its customers must surely be existing District Railway passengers, who desire to shorten the time of their journey to and from the City. . . . . The conclusion of the whole matter would then seem to be that here, as in every other case of recent years, it is exceedingly difficult to see how a commercial profit can be made out of supplying the undoubtedly crying needs of the London public in the matter of railway transport. In this case the thing may possibly be done by economy and good management. There is certainly, however, no margin for financiers' profits, and it is difficult to see the justification for a 40 per cent. rise in the market quotation of Metropolitan District Railway stock.

Light Railway.—A proposal to lay a light railway to Flamborough is to be considered by the Town Council.

Liverpool.—A committee is recommending the Council to apply for a provisional order to authorise the carrying out of considerable extensions to the existing tramway system, and to employ mechanical power as the means of propulsion.

Motor Cars for Ceylon.—*Indian Engineering* states that Mr. R. K. MacBribe, Director of Public Works at Ceylon, has recommended the introduction of motor carriages or horseless carriages into Ceylon for the conveyance of passengers and mails from Matale to Anuradhapura and Jaffna, Kurunegala to Puttalam, Kurunegala to Trincomalie, Badulla to Batticaloa, and Matara to Hambantota, and that they should be under the direction of the Public Works Department, the factory engineer being appointed superintendent.

Portsmouth.—At the Corporation stables electric current is utilised for chaff cutting. The Electric Light Committee has just reduced the charge per unit for this purpose from 5d. to 2½d.

Swansea.—So far as the shareholders in the Swansea Tramways Company are concerned, the adoption of the overhead electric system for the tramways has been approved. Hand in hand with this proposal is the adoption of an agreement with the Corporation under which the company agrees to sell its undertaking in exchange for a fresh lease. The chairman, in laying the facts before the shareholders on Friday last, said that there was good reason to believe that the system of electrical traction by overhead wires was the best, and that it had, as a rule, led to increased income from passengers, together with reduced cost of working. The improvements portion of their company would continue as before, the two capitals having been separated. They would start fresh with newly-laid and well-equipped lines, for the rails in any case would soon have needed renewal. He thought the Swansea Corporation ought to be very well pleased with the agreement, and he hoped that the shareholders of the company might also find it to their advantage. He roughly estimated the rental they would have to pay on the existing lines at between £5,000 and £6,000 per annum. The preliminary agreement was approved, and the directors were empowered to take all necessary steps for carrying it into effect.

TELEGRAPH AND TELEPHONE NOTES.

Antwerp-Berlin Telephone.—A daily contemporary states that an important development of telephony on the Continent will, it is expected, take place in the near future. Recent trials between Antwerp and Berlin have been so far successful that the work of placing the two cities in direct communication will shortly be proceeded with.

Buenos Aires.—A River Plate contemporary says that the Government has forwarded to Congress a scheme drawn up by the City Fire Brigade for the establishment of a complete service of electrical fire calls throughout the capital, similar to those established in London. The cost is estimated at about $50,000 gold.

Cable Repair.—On 13th inst. H.M. telegraph ship *Alert* left Dover Harbour, and proceeded to Dieppe to repair a Channel cable.

Chilian Cables.—Early in September soundings were being taken for the laying of a cable between Sandy Point and Port Montt (Chili), and the engineers engaged upon the work were looking out for the suitable situations for the stations. This cable, says the *Review of the River Plate*, will be in connection with all the other Chilian cables. The contract for the work is in the hands of the India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

Explosion on the Cable Steamship "Scotia."—Recently, says the *Engineer*, the Telegraph Construction and Maintenance Company's iron steamship *Scotia*, 2,931 tons register, Captain Cato, put into Plymouth from about 60 miles south-west of the Eddystone, where a terrific explosion occurred on board, narrowly involving the loss of the vessel. The *Scotia* met with a heavy gale after leaving London, but no damage was caused. In anticipation, however, of encountering heavy seas off Ushant and in the Bay it was decided to make fast everything movable. With this object the boatswain, carpenter, and an able seaman descended into the forepeak at 4 p.m. on Thursday, taking with them an ordinary globe lantern. They had scarcely commenced making the stores secure when a great explosion of gas occurred, the three men being burned by the flame, two seriously. There was immediately a tremendous inrush of water, but the men safely escaped to the deck. The explosion shook the ship from stem to stern. Boats were swung out and hastily provisioned, the orders being executed with promptitude, under the direction of Captain Cato. In the meantime some of the crew went below to find out what water the ship was making, and it was found that the collision bulkhead was broken, but that the next bulkhead had successfully resisted the sea. This compartment was shored up, and hopes were entertained of the ship keeping afloat. It was, however, deemed advisable to signal a steamer in sight to "Stand by." She proved to be the Plymouth steamship *Maristow*, and immediately responded to the signal, and bore down to the *Scotia*. As the vessel was broached round for port, it was possible to gain some idea of the extent of the damage. The port bow was completely blown out for a considerable distance above and below the waterline, and the starboard bow plates for a similar distance were left hanging, causing an enormous gap, into which the water poured. The *Scotia* is the old Cunard liner of that name, built in 1862, and but for her substantial construction must have foundered. The explosion is assumed to be due to the escape of inflammable vapour from less than 2 cwt. of anti-corrosive oil stored in the fore peak. It is well known that many substances used for coating ships' bottoms contain naphtha, and by some means, it is believed, that this highly dangerous chemical escaped. The fore peak is well ventilated, and a few hours before the accident the boatswain went down with a lantern, and did not detect any smell of gas.

Fife and the Telephone.—The Fife County Council has been going into the question of an independent telephone system, and a committee has received three offers, varying from £1,300 to £1,700. The Committee recommends that such a system be erected, as the present system is causing great dissatisfaction. The proposal has yet to go before the Council, and after that, we presume, the National Company and the Post Office authorities, will have something to say.

Glasgow.—Three years ago Glasgow was astir on the telephone question. The local service was inefficient, and the Corporation wanted to put down a municipal telephone system. Application was duly made to the Postmaster-General for a license. The matter rested there. Now, however, the Glasgow Chamber of Commerce has brought the subject up again, and on 19th inst. discussed it at length, with the result that 10 voted for, and 11 against, a motion to memorialise the Postmaster-General in support of the three-year-old petition.

Isle of Man Telephones.—There is a movement on foot for the extension of telephonic communication in the island.

River Plate Telephone Service.—We learn from a foreign contemparary that on August 30th the majority of the employés of the United River Plate Telephone Company struck for a 50 per cent. increase in wages, and the suppression of fines. The company refused the demands, and dismissed the men. A rise in wages had been arranged, by consent of the London board, for September.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Brest-St. Pierre (Anglo, 1869)	April 6th, 1895 ...	...
Puerto Plata-Martinique ...	Dec. 19th, 1895 ...	...
Monte Alegre-Santarem ...	May 5th, 1896 ...	...
Para-Maranham	Oct. 8th, 1896 ...	...
Landlines.		
Trans-Continental line beyond Mazol	March 12th, 1896 ...	...
Carthagena - Barranquilla (Columbia)	July 4th, 1896 ...	...

The Pacific Cable.—The *Pall Mall Gazette* understands that the Hon. Duncan Gillies, one of the Australian delegates, with Sir Saul Samuel, at the Anglo-Colonial Cable Conference, and Agent-General for Victoria, is about to retire from the latter post. He may desire to return to Victoria, in which case another Australian delegate will have to be appointed to the Cable Conference.

The Canadian Cabinet, on Wednesday, formally appointed Sir Donald Smith, Mr. Sandford Fleming, and Mr. A. G. Jones, of Halifax, Nova Scotia, a member of the previous Liberal Ministry, as Canadian Commissioners to the Pacific Cable Conference, to be held in London on November 9th.

Threatened Strike of Telephone Operators.—It is reported that dissatisfaction is rife among telephone men in Yorkshire and the northern districts in consequence of a notice which has just been issued by the National Telephone Company. Under the new arrangement the company's men will be required to work 53 hours per week instead of 50, as heretofore, without extra remuneration.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belgium.—October 28th. The Société Nationale des Chemins de Fer Vicinaux, in Brussels, is inviting tenders for the conversion of about 23 kilometres of "Vicinal" railways in the Charleroi district, into electric lines on the overhead conductor system. Particulars may be had for 1 fr. from, and tenders to be sent to, the Société Nationale des Chemins de Fer Vicinaux, 26, Rue de la Science, Brussels.

Bradford.—Tenders are required by the borough electrical engineer (Mr. Gibbings), for a quantity of electrical meters—Aron, Frager, Edison, and Oulton-Edmondson.

Dublin.—The Dublin Bread Company, Limited, wants tenders for a motorvan.

London.—October 26th. Tenders are wanted (*a*) for the supply of red fir telegraph poles, and (*b*) for creosoting the poles with 10 lb. or 12 lb. of creosote to the cubic foot, as may be directed, for the Postmaster-General. Forms of tender, containing all particulars, may be obtained on application to Mr. Chas. E. Stuart, controller of stores, General Post Office, E.C.

Madras.—Nov. 11th. Lieut. Col. C. C. Rawson (in charge Consulting Architects' Division) invites tenders for the lighting by electricity of Government House, Madras, including the banqueting hall and the A.D.C.'s bungalow: also for the lighting of Government House, Guindy, including the Military Secretary's bungalow. Particulars to be obtained on application to the Consulting Architect to the Government of Madras, Chepauk, Madras.

Monmouth.—November 2nd. The Town Council invites tenders for the following contracts:—No. 1.—Machinery (consisting of turbines, alternators, steam engines, boilers, electric motors, sewage pumps, &c.); No. 3.—Cast-iron pumping main; No. 4.—Electric lighting mains. Particulars on application to Messrs. Bramwell and Harris, engineers, 5, Great George Street, Westminster, S.W. or to the town clerk, Monmouth.

Roumania.—November 16th. The Municipal Authorities of Bucharest are inviting tenders for the supply and erection of two auxiliary steam engines at the hydro-electric central station at Grozaresti. Tenders to be sent to La Mairie, Bucharest, Roumania.

Spain.—October 27th. Tenders are being invited by the Municipal Authorities of Ayelo de Malferit (Valencia province) for the concession for the electric lighting of the town during a period of 5 years. Tenders to be addressed to El Secretario del Ayuntamiento de Ayelo de Malferit (Valencia).

Swindon.—October 26th. The Great Western Railway Company are prepared to receive tenders for the supply of stores, including telegraph apparatus, tools and drysalteries, electric light carbons, zinc, wire, telegraph poles, &c., &c. Full particulars were given last week in our "Official Notices."

Torquay.—November 3rd. The Town Council invites tenders for boilers, alternators, pumps, mains, transformers, meters, accumulators, crane, &c., for the electric light installation. Particulars may be obtained of Mr. W. H. Trentham, of 39, Victoria Street, S.W. or the town clerk.

CLOSED.

Bath.—We are informed that the following contracts have been given out by the Town Council. Boiler house plant (Babcock boilers):—Electric Construction Co. £2,462; engine house plant (fly-wheel alternators):—Electric Construction Co. £8,364; underground works:—Callender's Cable and Construction Co. (cables) £7,985; Electric Construction Co. (converters) £470; overhead travelling crane:—Stothert & Pitt £350; total £19,631. The tenders for the arc lamps and posts are still under consideration.

Buenos Aires.—Tenders were recently accepted by the Buenos Aires authorities for telegraph material for new lines as follows: Messrs. Otto Straube, Santiago J. Carbone, and A. Giordano. We also hear that the Government has decreed the construction of a telegraph line from Lavalle to Jacoli, in the province of Mendoza.

France.—The French Post and Telegraph Authorities, in Paris, lately invited tenders for the supply of 137·7 kilometres of paper-insulated electric cables. The tenders were adjudicated on the 8th inst., when 11 lots were placed with Messrs. G. Aboilard & Co., of Paris—seven lots at 53,100 francs each, one lot at 30,750 francs, one lot at 30,000 francs, one lot at 30,750 francs, and one lot at 54,600 francs. The Société Industrielle des Telephones, of Paris, secured one lot at 39,816 francs.

Glasgow.—The Electric Committee has accepted the tender of Messrs. Callender's Cable and Construction Company for 4½ miles of electric service cables.

Hackney.—The Vestry has accepted the tender of Messrs. Laing, Wharton & Down for wiring and fitting up the Town Hall with electric lighting for the sum of £1,254.

London.—The tender of the Private Wire and Telephone Installation Company has been accepted by the Wandsworth and Clapham Guardians for a telephone installation at Tooting Home, a large building now nearing completion. Telephones are to be fitted in all the departments on each floor, and the wiring is to be on the "intercommunication" system. All the instruments are to be magneto-ringing, fitted with Hunnings' transmitters. The infirmary, &c., under the control of the same board, at Wandsworth, is already fitted on the same system by this company.

Surbiton.—The lower floor of the Assembly Rooms is to be lighted electrically; the contract for the work is in the hands of Messrs. New & Mayne.

NOTES.

Fire Protection of High Buildings.—This question does not affect us to anything like the extent that it does our trans-Atlantic friends. Yet there are occasional occurrences in this country which demand that the matter shall not be entirely overlooked. At a recent meeting in America of the International Association of Fire Engineers, when the question came up of protecting or saving the modern tall office building, it was remarked that they ought to let such buildings burn down to the water reach. Another opinion was that there were means of getting at a fire even if it was on the top floors of a 150-foot building. Attention was called to electric pumps, which could be used at any altitude, and the motors of which could be kept running a long time if necessary. The desirability of keeping the electric light service going was also pointed out, and electric elevators were also noted, the use of an elevator in carrying up a line of hose, instead of dragging it up the stairs being obvious. The New York *Electrical Engineer* has heard it suggested that lines of water pipe should be hidden under the cornices of these tall buildings, the valves to be released electrically at the moment of need, so that flames from outside encounter a complete water sheet, which keeps them off.

Evening Classes.—From our "Official Notices" particulars will be obtained of evening classes in electrical engineering which are being held at the Battersea Polytechnic. In addition to the ordinary lectures and laboratory instruction there will be trade classes in electric wiring and house fitting and electrical workshop practice.

Note on Ozone.—So much interest has centred round this gas in connection with the electrical methods of producing it, and so many differences of opinion have been expressed regarding it, that it may be worth while, perhaps, to notice a piece of recent work by C. Engler and W. Wild, which is published in the *Berichte der Deutschen Chemischen Gesellschaft*, Vol. 26, p. 1929. From the experimental work detailed in this communication, it is concluded that there is now no reaction known by which a modification of oxygen is produced by the decomposition of ozone which can be regarded as the antozone of Schönbein, Meissner, and others, or as the free ions (— O —) or incompletely combined atoms (— O — O —) of Helmholtz and Richatz.

Problems.—A contemporary which poses as the guide, philosopher, and friend of municipal electric lighting committees, engineers, &c., seldom touches upon anything more scientific than the fixing of a lamp-post, but on the rare occasions when anything connected with electrical or magnetic problems are entered upon, the display of antiquated and obsolete notions is most amusing. The "Problem in Electro-Dynamics" has fairly unbalanced the meteoric intellect and thrown it into a chaos of lines of force, equipotential surfaces, points in space, and tubes of force, in an endeavour to educate its younger readers; they must be very young, indeed, to be treated to such infantile instruction. The serious may consider themselves fortunate in being allowed to sit at the feet of such a modern Gamaliel.

Crystal Palace Old Students.—The second annual dinner of the Crystal Palace Old Students' Society will take place at the Trocadero Restaurant, Piccadilly Circus, W., on Wednesday, October 28th. This Society, we understand, is composed exclusively of those members of the engineering profession who have received their preliminary training at the Crystal Palace Company's School of Practical Engineering. The hon. secretary is Mr. J. C. Lyell, of 55, Victoria Street, S.W.

Personal.—Mr. Wilfred D. Bailey, who was for many years connected with the business of the India-Rubber, Gutta-Percha, and Telegraph Works Company, in Buenos Aires, has, after a short absence, returned to that city. He has now joined Mr. Charles Bright, a prominent electrical contractor there, and is at the head of the electrical supply department.

Those who have met Mr. Wünschendorff, and those who have read his treatise on submarine telegraphy, will be interested to learn that he has been advanced by the French Government from the position of Directeur Ingénieur of the Paris District to that of Inspecteur Général des Postes et des Télégraphes, in the room of M. Amist, retired.

Mr. J. Moir, engineer of the Postal Telegraph Department, Leeds, has been promoted to the position of assistant superintending engineer at Newcastle-on-Tyne. A farewell dinner was given in his honour at the Leeds and County Liberal Club on Wednesday last week.

Mr. John J. Bowman, formerly manager to Messrs. Walter Dixon & Co., of Glasgow, has been appointed manager and agent for the Oriental Telephone and Electric Company, Limited, in Rangoon and Moulmain.

Institution of Junior Engineers.—The annual general meeting of this Institution was held at the Westminster Palace Hotel on the 16th inst., the retiring chairman, Mr. H. J. Young, presiding. There was a large attendance of members. The Council's annual report, which was read by the secretary, Mr. Walter T. Dunn, showed that the total membership was now 454, an increase of 36 on the past year. Mr. A. R. Binnie, M. Inst. C.E., was the president for the ensuing sixteenth session. The following appointments were made:—Chairman, Mr. H. B. Vorley; vice-chairman, Mr. Basil Joy; hon. librarian, Mr. H. Kempster; hon. auditors, Messrs. W. H. De Ritter and P. Marshall; members of council, Messrs. Adam Hunter, E. Berry, K. Gray, Bertram Joy, A. Anstruther Thomson, G. F. Burtt, E. King, and Walter J. Hunter.

Correspondence.—We regret that a letter received from Mr. H. W. Appleby on "Electricity in Mines" has been crowded out of this issue.

A Matinee.—On Saturday afternoon last an electrical friend invited us, with as many companions as we could get together at short notice, to a—we will call it a *séance*—at the—well, if the truth must be told—Royal Music Hall, Holborn. The Salambos were to give an exhibition of the electric arc produced between two ordinary carbon rods, one held by the gentleman the other by the lady, the current, our friend seriously informing us, passing *through* the bodies of the performers. Bearing in mind the revelations made before the Licensing Committee of the London County Council on the question of Music Hall Licenses, we selected some of the most modest and retiring members of the electrical profession, and, eight in all, the party sallied forth, but no sooner had we arrived at our destination a little before the opening of the doors, than the horrible thought struck us that we should be taken for agents of either the National Vigilance Society or the British Women's Temperance Association. As luck would have it, however, several of our party had come provided with formidable looking boxes of testing instruments and batteries, so the crowd concluded that we were going to give an "extra turn" in opposition to the Boisset troupe. Still, we cast many furtive glances around as we were shown to the stalls, lest, perchance, we should be ogled by Mrs. or Miss Reed, and we were only too glad to get comfortably seated without being challenged by Mr. Coote or his myrmidons. While patiently awaiting the appearance of the Salambos, we were all on the alert for anything in the way of diagrams of feet, short white socks, several inches of bare limb, an indecent ring in the voices of the singers, and so on *ad nauseam*, but we were doomed to disappointment; they weren't there, and we never got near *La Source*. Not even a girl came and looked us right in the face, so when the fire-eaters and arc-producers came upon the stage we gave a sigh of satisfaction, for we knew that *our* turn had come. One man adjusted his Silvertown testing set, another tried the voltage of his 100-cell battery, a third turned his X ray apparatus on the performers, the fourth brought out a pair of exploring needles with which he intended probing those gorgeous robes of Mrs. Salambo, a fifth talked learnedly of high frequency and Tesla effects, and the remaining three, a B.Sc. amongst them, were searching for whiskies and sodas, and seemed to have been successful. For ten minutes the Salambo's like salamanders seemed to revel in sparks and flames, and then came the *pièce de resistance*, the "human arc." If our readers want to know how its done, we recommend them to go and find out for themselves. The performance is a capital one, and after it is over they will go away with the reflection that Mr. Salambo has still "something up his sleeve," and that Mrs. Salambo's bare arms are—well, decidedly worth seeing, and that the ribbons which hang so gracefully from her shoulder strap to that dainty wristlet are not there for nothing. That the current passed through the *system*, as Mr. Salambo naïvely announced to his audience, we have no doubt.

The Electro-Harmonic Society.—For next Friday's concert a programme somewhat more diversified than usual has been arranged. Instrumental music will have greater prominence, and amongst the items will be noticed Gounod's sublime "Ave Maria" for voice, violin, piano, and organ, and Adam's beautiful "Cantique de Nöel." With singing, legerdemain, recitations, and humorous sketches, in addition, the programme should suit all tastes.

"Financial News" v. Pulvermacher.—This was a case which came before Judge Lumley Smith in the Westminster County Court, on Monday last, on an application by defendants for the action to be struck out with costs. Counsel for the defendants said they were Messrs. Pulvermacher & Co., manufacturers of an electric belt. Plaintiffs threatened to expose defendants and fight this action to the bitter end, but they suddenly gave notice of withdrawal, and declined to pay all the costs.—His Honour gave defendants judgment in the action with costs.

Ohm Memories.—The *Globe* says it is proposed to erect a monument over the grave of Georg Simon Ohm, the famous electrician. Subscriptions will be received by the Konigliche Filiabank, Munich.

Storage Battery Traction.—On Monday, October 5th, a public trial of the new electric motor was made on the 34th Street branch of the Manhattan Elevated Railroad. Especial interest, says New York *Electricity*, attached to this trial, in that the operation of the motor involved a principle not heretofore publicly tried. Street cars have been operated by storage batteries located at the power station, and by batteries located on the cars themselves; but in this case the storage battery was in use in both places, and the two sources of power connected by a trolley in the shape of a third rail. The total power consisted of 256 cells, 56 of which were placed on the motor as regulator cells, and the remaining 200 at the power station. The outgoing current from the latter was carried by a third rail at the side of the track, and current taken from it by a sliding steel shoe, as on the intramural road at the World's Fair. The motor car cells, insufficient in themselves to operate the car, receive charge when the line requirements are small, storing up the energy so as to assist the power station battery when the requirements are large. Since they are constantly charging or discharging, as the demands vary, and are never called upon to do much work, they need not be of large capacity, and thus may be made light, and since by their fly-wheel effect they tend to counterbalance any sudden fluctuations in line loss, conduce materially to the smooth operation of the road. The motor car in question is of an ungainly shape, and, says our contemporary, might easily be improved in appearance by a blind man. It is 8 feet high and 18 feet long, and mounted on an old elevated locomotive truck. In the trial referred to it worked well for a few trips, but finally became stalled through some defect, which later was remedied, and trips resumed.

Electric Mining in the Rocky Mountains.—A paper was read by Mr. Irving Hale before the American Institute of Mining Engineers, recently, treating of the advantages of electric transmission of power and of the general principles governing electric power plants. A large table is given with a list of electric plants in the Rocky Mountain region. The different applications of electricity are discussed, and the paper says, in conclusion, that during the past eight years, and principally in the last four years, 52 distinct companies in the Rocky Mountain district alone have installed electric power machinery for mining and ore-reducing purposes, comprising 62 generators, aggregating 7,988 kilowatts, and 135 motors, aggregating 4,816 H.P., operating every variety of mining and milling machinery. Electric apparatus, formerly regarded as delicate and peculiarly subject to breakdowns, has been brought to such a degree of perfection that depreciation and repairs may be considered as less on this than on almost any other kind of machinery. The multiphase high-voltage system has brought nearly every mining district within economical reach of water-power. The induction-motor, without commutator, collector or brushes, is both simple and durable. Electro-metallurgical operations are increasing and give promise of success. Under these conditions, says a New York paper, it may be safely predicted that during the next five years much greater progress will be made, and the application of electricity will become one of the most attractive and important features of mining economy.

The Autographs of Electricians.—In a recent issue of our now defunct contemporary, *Electric Power* (U.S.A.), there is an interesting article, which marks quite a new departure in technical journalism. The editor has collected a number of autographs, portraits and letters, from leading electricians, and these are well reproduced, together with some very readable comments. Of course, as might have been expected, the leading place is given to Mr. Thomas A. Edison, and the other American electricians; but there are also some signed letters by Hertz, W. H. Preece, and J. Wimshurst. It is a pity that this article, which is so full of promise, is not a series of articles in which portraits and signed letters from all the leading electricians throughout the world are incorporated. Though scarcely suited to our pages, we commend the idea to some of our contemporaries who cultivate the more popular style of journalism. Indeed, a very interesting little book might be compiled of such matter. Perhaps somebody will take it up.

The Hardie Compressed Air Motor.—The *Scientific American* describes the Hardie system of motor car and the details by which compressed air working is brought into more economical lines. The losses inevitable to air working are the heating of the air when compressed, whereby so much more is required to compress it than can be recovered when the cooled air expands and does work, and the converse refrigeration when expanded and the reduced power available. The freezing difficulty also comes into play. In the Hardie system compression is conducted on the compound system, in three stages. This allows of complete cooling between each stage, and the heat of compression is taken up by cold water, afterwards fed to the boilers. The air is finally forced at 2,000 lbs. pressure into a reservoir, whence it is fed to the cars. The cars are carried on a four-wheeled truck, and contain 16 air holders 20 feet long × 9 inches diameter. Beneath the floor is a vessel 7 feet long and 18 inches diameter, holding 500 lbs. of water. A car is first charged with air at 2,000 lbs., and the 500 lbs. of water are steam-heated to 350°. These operations take less than one minute. In operating a car the air is first let down to 150 lbs. pressure and admitted to the heater tank, where it absorbs heat from the water. Each 50 cubic feet of air carries the equivalent of 26 cubic feet of air in the form of steam. The air itself is expanded, and the net result is 100 cubic feet. Latent heat is set free by the steam as it condenses, and freezing is prevented. According to General Haupt in a series of trials, 308 feet of air were used with the heater in use, without the heater 661 cubic feet were used. The motor cylinders are 7 inches diameter × 14 inches stroke. Ordinary Stephenson link valve gear is employed, but with a back-slide cut-off valve. It would appear to us that if air is to be successful as a motive power, something of the nature of the Hardie system will be necessary. But the whole has a strong whiff of steam about it, and there are very considerable pressures to be dealt with, which will demand great care and attention on the score of public safety as well as in respect of losses by leakage.

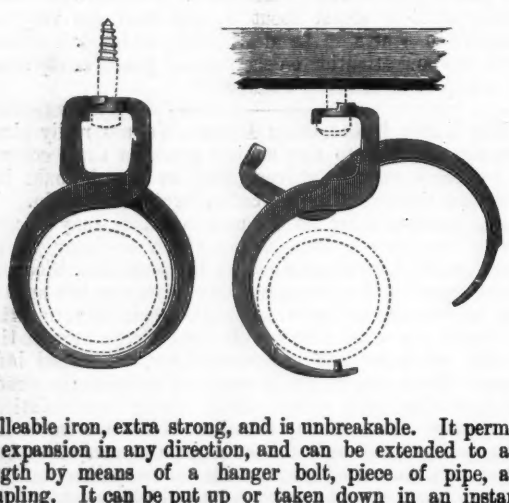
The Keely Motor Once More.—We are really almost ashamed to refer to this subject again in these columns, as we think we have driven, what we hoped would have been the final nail in its coffin, again and again. We must, however, refer to it once more, if only for the sake of recording a little history which we fancy we predicted would come about when we discussed Mrs. Bloomfield Moore's *apologia* for the man Keely a year or two ago. It may be remembered that this philanthropic lady undertook to supply the man Keely with funds for a certain time, during which he doubtless assured her, as he had before assured others, that he would be able to complete the wonderful invention, with which he is going to revolutionise everything. We must say that Mrs. Moore was most loyal to her *protégé*; not only did she supply the man with money, but she also canvassed his great idea in every direction. We recently learnt that the contract into which she entered with him, has terminated, which is certainly bad for Keely, but which must be a matter of congratulation for Mrs. Moore. We only wish that this single-minded philanthropist had taken our advice some time ago and renounced the individual and all his works, for according to the *Saturday Review*, of Philadelphia, she has now expressed her opinion that there is no commercial value in the concern whatever which would warrant an appeal to the public for more funds. And so *Hic jacet*, some more hundreds of good dollars! We hope that by this time the American public will have had their fill of the Keely motor, and that we shall soon be able to write an appropriate epitaph upon the Great Idea which, for so many years, John W. Keely has been exploiting with so much financial success—*to himself*.

The Autocar Race.—It has now been arranged that the race of horseless carriages between London and Brighton will take place on Saturday, November 14th, as originally arranged. Between 30 and 40 autocars are expected to meet at the Hotel Métropole at 10.30 a.m. on that day.

The Institution of Junior Engineers.—A visit will be paid on Saturday, October 31st, at 3 p.m., to the Hôtel Cecil, to inspect its electric lighting, hydraulic, warming, and other engineering features.

Electric Tramways with Accumulators.—In reply to the assertion that the application of accumulators for working tramways has been neither a technical nor an economical success, the following statements have been communicated from a well-informed quarter in Hanover. The experience gained has shown that accumulator working is quite capable of surviving in certain special circumstances. The working of the tramways has not been more troublesome; on the contrary, accumulator driving has been found to be the least troublesome of all systems. It is granted that the accumulator is still capable of improvement, but there is, at least, as much necessity for improvement in the electromotor part. Experience has shown that all breakdowns can be easily and quickly set right, since they must of necessity be confined to one car; breakdowns in the overhead system, on the other hand, often stop for a long time the traffic on the whole line. It may be admitted that the overhead system is more economical, but it has been undoubtedly established that accumulators are less costly than horses for working tramways. Æsthetically, the accumulator has the advantage over the overhead conductor. But though the latter advantage may not be great, it is undoubted that accumulator driving will be preferred to the overhead system in the centres of large cities.—[*Zeit. f. Elektro.*, p. 626]

The Clark Pipe-Hanger.—The Buffalo Engineers' Supply Company are supplying the Clark pipe-hanger, which is a device of novel design, and possesses many advantageous points. It will swing in any direction. It is designed, according to our trans-Atlantic namesake, for use on steam, water, gas, or oil piping. It is made of strictly high grade



malleable iron, extra strong, and is unbreakable. It permits of expansion in any direction, and can be extended to any length by means of a hanger bolt, piece of pipe, and coupling. It can be put up or taken down in an instant. Lag screws are not furnished with these hangers, owing to the various lengths used, and the fact that this hanger will clasp any standard lag, screw head, bolt or nut, but standard lag screws or hanger bolts, with pipe thread at market prices, can be supplied if desired.

Appointment Vacant.—The Worcester Electricity Committee wants an electrician-in-charge for the electricity works. Salary £90 per annum. For further particulars see our "Official Notices."

Appointment Vacant.—The Blackpool Corporation want an electrician at £2 10s. per week to act as mains' superintendent. For further details see our "Official Notices."

Marriage.—Mr. George C. Sillar, for the past 12 years works manager of the Brush Electrical Engineering Company, Limited, was married on Wednesday last, and to mark their respect and esteem for him, some of his friends and colleagues in the company have celebrated the occasion by presenting him with a carriage clock. Mr. Sillar has just completed his fifteenth year of service in the Brush Company.

Obituary.—Mr. David C. Sprague (father of Lieut. Frank J. Sprague, the well-known American electrical engineer and inventor, to whom we offer our sympathy), was killed by an express train while crossing the track on September 24th, at Rahway, N.J. Mr. Sprague, who was 63 years of age, at one time represented the Sprague Electric Railway and Motor Company in Buenos Aires.

The death occurred, on 12th inst., of Mr. W. J. Wilmot, who had for some time been engaged in the Midlands by Messrs. Verity & Sons upon important works. He was only 36 years of age.

The death is announced of M. Fizeau, who will (says Mr. A. Gray, in *Nature*), rank high among those who have contributed to the scientific distinction of the nineteenth century. He was well known for his experimental method of determining the velocity of light, and also for his experimental determination of the amount of drift of light-waves in a transparent medium in motion. He was elected a foreign member of the Royal Society in 1875, and received the Rumford medal of the society, in recognition of his scientific work.

Mr. J. H. Greathead, whose name will long be remembered in connection with underground tunnelling in London, particularly in electric railway work, died somewhat unexpectedly on Wednesday.

The Central London Railway Fatality.—At the inquest on the body of Wm. Creighton, the man whose sad death we recorded last week, the jury, after hearing a good deal of evidence, brought in a verdict of "accidental death," adding that, "in future, notice should be given to manufacturers of the special use for which the wire ropes are required."

Acetylene Explosion.—Two men were killed at the Pictet Works, Rue Championnet, Montmartre, on 17th inst., by an explosion caused through the bursting of a vessel containing acetylene gas.

Application re Patent Specification.—From our "Official Notices," it will be observed that Emil Lanhoffer, of Mulhausen, Alsace, has applied for leave to amend specification No. 9,650, of 1896, for "Improvements in electromotors and dynamos, and in apparatus for use therewith."

Langley's Bolometer.—Prof. Langley's remarkable instrument, known as the bolometer, occupying the entire building of the astro-physical observatory attached to the Smithsonian Institution, is pronounced by Rene Bache the most delicate mechanical contrivance ever devised, inasmuch as its "senses" are more acute than those of any human being. Outside of the building a huge machine, the inside works of which are a clockwork mechanism, pumps sunshine through a long tube into a dark room where the bright ray passes through a prism; the latter is not of glass, because glass is opaque to the invisible rays of the solar spectrum, but is of rock salt, carefully cut to a certain angle by the famous optician Brashear, and, though the prism looks almost opaque to the eye, it is as crystal to the invisible rays above the violet and below the red. Thus, says the *Scientific American*, the operator is able to follow the invisible rays along their dark path, their presence and potency being accurately registered, having for its most essential part a balance composed of a thread of spun glass and a tiny mirror, the latter attached to a piece of a dragon fly's wing.

A Tubular Ozone Generator.—There is a certain amount of novelty in a new ozone generator, which was recently exhibited before the Paris Academy of Science, by Gaston Séguy. The generator consists of a glass tube containing seven narrow tubes, each of which has a spiral of aluminium wire inside and outside. The inside spirals are all connected with a single wire which passes to the outside of the tube, whilst the external spirals are similarly connected with another wire. These wires are respectively connected with the two poles of an induction coil. In using these generators, three or more may be connected in series, and Séguy states that when operating with air, as much as 170 milligrams of ozone per hour can be obtained, and that this amount rises, in the case of oxygen, to 250 milligrams per hour. A more complete description of this generator will be found in the *Comptes Rendus*, 1896, Vol. 122, p. 1120.

Electricity and Fire Risks in the United States.—The New York *Insurance Chronicle* has published its yearly tables setting forth the annual fire loss in the United States. The greatest interest with us naturally centres round the list of the fires caused by electric wires or lights. Figures are only available for ten years back, for previous to that there was not sufficient electric lighting work done to materially affect the insurance people. In 1895 there were 249 fires caused by electricity, as against 217 in 1894; but the fires caused by exposure to those started by electricity numbered only 89, instead of 169 in the former year. So the total number of fires caused by electricity was 338 in 1895 and 386 in 1894, a very marked falling off. It is evident, says a contemporary, that greater care in insulating wires and in other matters connected with electrical plants is taken.

The Magnetic Properties of Alloys of Iron and Antimony.—In the *Comptes Rendus*, 1896, Vol. 123 (4), p. 227, J. Laborde gives an account of some researches which he has been making respecting the density of specific heat and other physical constants. He also made some observations on their magnetic properties. The results in general accord with the observations of Weiss, who showed that the magnetic properties of these alloys increased rapidly when the proportion of iron either exceeds or falls below that corresponding to an alloy having the composition $Fe_3 Sb_4$.

Induction Coils.—Messrs. Willyoung & Co., of Philadelphia, are the makers of an induction coil which contains some notable improvements, and is especially well adapted for X ray experiments. The iron core is of the best Norway iron wire, specially annealed, and each component wire is covered with a thin layer of shellac. The secondary coil is wound in small sections in the usual way, and the coil, as a whole, is saturated with a special insulation, in such a way as to thoroughly exclude air. In coils of 6, 8 and 10-inch spark, not more than 1 lb. of No. 34 B & S wire is used per inch of spark length, while the discharge in each case is exceptionally solid and heavy. A new feature of great importance, incorporated by Messrs. Willyoung & Co, in their induction coils, is a variable condenser, as a substitute for the condenser of fixed capacity usually employed. Since the best capacity of a condenser of an induction coil depends on several factors, some of which are variable, it is evidently desirable that the capacity should be capable of adjustment within certain limits. These variable condensers are also made up for general experimental work, such as the study of resonance phenomena, alternate current investigations, &c. A 10-microfarad condenser is made up of 10 sections of $\frac{1}{10}$th microfarad each, and nine sections of 1 microfarad each. The required sections are switched in by a rotary switch, similar to that used in a controlled rheostat. For material of construction, tinfoil and a specially selected brand of unsized paper are cut to proper dimensions, and stacked together dry. These pieces are then subjected to a peculiar insulating process, by which every part is permeated by a solid dielectric, both air and moisture being thoroughly and permanently removed.

NEW COMPANIES REGISTERED.

Laing, Wharton & Down, Limited (49,645).—Registered October 8th; capital, £30,000, in £1 shares (6,000 5 per cent. cumulative preference), to acquire the business of electrical engineers and contractors, carried on by C. J. Wharton, A. F. Davies, and F. J. Down, at 82a, New Bond Street, W., and elsewhere, as "Laing, Wharton and Down," to enter into an agreement with the said vendors, and to carry on the business of electricians, electrical and mechanical engineers, suppliers of electricity, and electrical apparatus manufacturers. The subscribers (with one share each) are: A. F. Davies, 82a, New Bond Street, W., electrical engineer; C. J. Wharton, 10, Gayton Road, Harrow, engineer; H. K. Smith, Kingsfield, Watford, engineer; F. J. Down, Milton Road, Harpenden, engineer; W. Howard, 27, Clement's Lane, E.C., C.A.; A. W. Lipsham, 1, Fredericks Place, Old Jewry, E.C., clerk; G. Cruikshanks, 1, Fredericks Place, Old Jewry, E.C., clerk. The number of directors not to be less than three, nor more than seven. The first are J. F. Down, A. F. Davies, and J. Eck. Qualification £100; remuneration £250 each per annum. Registered office 82a, New Bond Street, W.

Hartlepool's Electric Tramways Company, Limited (49,734).—Registered October 15th, with a capital of £50,000 in £10 shares, to adopt an agreement, dated August 29th, between S. P. W. D. Sellon, and F. Ashby, of the one part, and the British Electric Traction (Pioneer) Company, Limited, of the other part, and to construct and work the tramways authorised by the Hartlepools Electric Tramways order, 1895. The subscribers (with one share each) are:—S. P. W. D. Sellon, Broadway House, Westminster, engineer; E. Garcke, 1, Great Winchester Street, E.C., electrical engineer; J. V. Kitchener, 1, Great Winchester Street, E.C., secretary; J. T. Rossiter, Grove Park Road, Chiswick, electrical engineer; R. Doyle, 23, Pyrland Road, Highbury New Park, N., accountant; C. H. Dade, 3, Upper Winchester Road, Catford, gentleman; H. S. Hodgson, 41, Bassein Park Road, W., secretary. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification £50; remuneration as the company may decide. Registered office, 1, Great Winchester Street, E.C.

Westminster Manufacturing Company, Limited (49,744).—Registered October 16th with a capital of £50,000, in £1 shares, to acquire the business of George H. Kenning & Co., certain letters patent and rights, and certain freehold property and rights from M. Lachman, to enter into a certain agreement, and to carry on the business of metal stampers, mechanical and electrical engineers, machinists, fitters, millwrights, founders, wire drawers, tube makers, and metallurgists. The subscribers (with one share each) are: C. Luff, Woodham, Addlestone, Surrey, clerk; T. Morton, 4, Bidwell Street, Peckham, S.E., clerk; E. Sorrell, 50, Idmiston Road, Stratford, E., clerk; S. E. Newman, 72, Romilly Road, Finsbury Park, N., clerk; A. Blackman, 18, Argyle Square, W.C., solicitor; G. Beeson, 2, Clarendon Terrace, W., clerk; G. O. Roos, 167, Cromwell Road, S.W., solicitor. The number of directors is not to be less than two, nor more than five; qualification, £250; remuneration as the company may decide. Registered by Burn & Burridge, 11, Old Broad Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

S. Z. de Ferranti, Limited (31,808).—This company's annual return has just been filed. The whole capital of £100,000, in £5 shares (of which 2,000 are preference) has been taken up, and all excepting seven preference have been considered as paid; £70 has been called and paid on those shares.

Shropshire Electric Light and Power Co., Limited (33,262).—This company's annual return has just been filed. The capital is £25,100, in £2,500 £10 ordinary, and 100 £1 founders' shares; 295 £10 and 45 £1 have been taken up, and £2 5s. has been called on the former, and £1 on the others; £642 5s. has been paid, leaving £22 10s. in arrears.

Babcock & Wilcox, Limited (34,289).—This company's annual return was filed on September 26th. The capital is £240,000 in £10 shares (of which 10,000 are preference). All of these have been taken up, and 3,333 preference and 4,666 ordinary have been considered as paid. The full amount has been called on the rest, and £160,010 has been received.

Messrs. Rowland, Barnett & Co., Limited (40,774).—This company has just removed its registered offices from 8, Mosley Street, Newcastle-on-Tyne, to 41, Dean Street, in the same city.

Sunbeam Lamp Company, Limited (25,498).—This company's annual return was filed on August 28th. 1,732 shares have been taken up out of a capital of £25,000, in £10 shares, and 857 are considered as paid. £10 per share has been called on the rest, and £8,720 has been received, leaving £30 unpaid.

Spanish Telephone Company, Limited (41,589).—This company's annual return has just been filed. The capital of £16,000, in £10 shares, has been fully taken up, and all considered as paid.

Telescriptor Syndicate, Limited (47,635).—This company's annual return was filed on August 27th. 20,757 shares have been taken up out of a capital of £40,000 in £1 shares, and 20,750 of these are considered as paid. No calls have been made on the others.

United Electric Wire and Telegraph Works, Limited (47,260).—This company's statutory return was filed on August 6th. The capital is £6,000 in £1 shares, and 3,032 shares have been taken up, 2,993 of these have been issued as fully paid, and £1 per share has been called, and £39 paid on the rest.

Thomas Parker, Limited (40,973).—This company's annual return has just been filed. The capital is £75,000, in £10 shares, and 6,352 have been taken up. 1,750 have been considered as paid, and £8 per share has been called on the others. £35,896 has been paid, and £920 remains in arrears.

Single Wire Multiple Telephone Signal Company, Limited (16,857).—This company's annual return has just been filed. 324 shares have been subscribed for out of a capital of £5,000, in £10 shares; £10 per share has been called, and £3,240 paid.

Siemens Brothers & Co., Limited (4,777).—This company's annual return was filed on August 7th. The capital of £500,000 in £100 shares has been taken up, £85 per share has been called, and the receipts amount to £425,000.

South African Lighting Association, Limited (27,609).—This company's annual return has just been filed; 4,100 shares have been taken up out of a capital of £50,000 in £10 shares, and 105 are considered as paid; £10 per share has been called on the rest, and £39,950 has been received.

CITY NOTES.

Eastern Extension Telegraph Company, Limited.

The report for the half-year ended June 30th states that the gross receipts, including Government subsidies, have amounted during that period to £313,914, against £264,138 for the corresponding half-year of 1895. The working expenses, including £19,916 for cost of repairs to cables and expenses of ships, absorb £87,256, against £95,254 for the corresponding period of 1895, leaving a balance of £226,658. From this is deducted £4,028 for income-tax, £20,000 transferred to the fire insurance fund, £31,895 for interest on debentures, debenture stock, and contribution to sinking fund, leaving £170,735 as the net profit for the half-year. Two quarterly interim dividends of 1¼ per cent. each, amounting to £62,500, have been paid for the half-year, leaving £108,235, of which £75,000 has been transferred to the general reserve fund, and the balance of £33,235 is carried forward. The working of the Australasian tariff arrangement for the fifth year of guarantee, ended April 30th last, resulted in the guaranteed figure being again exceeded. This was due to the heavy gold mining traffic with Western Australia during the past year. In addition to the revision of the local rates referred to in the last report, and which took effect on July 1st last, your directors have decided to make substantial reductions of tariff between India and China, Japan, &c., to come into force on January 1st, 1897. Reductions in most of the company's through rates were also agreed upon at the International Telegraph Conference recently held at Buda Pesth, several of which will come into force on January 1st next, and the remainder on July 1st, 1897. The immediate effect will undoubtedly be a falling off of revenue, but it is hoped that in time the loss will be diminished by increase of business. The directors have the pleasure to report that the long-pending negotiations between the company, its partners in the China traffic—the Great Northern Telegraph Company—and the Chinese Telegraph Administration, for a friendly working arrangement, have at last been brought to a satisfactory conclusion. The arrangement not only restores amicable relations between the administration and the companies, but settles the troublesome question of exchange, from which the company has so severely suffered in the past, by enabling it to collect in Chinese currency a fair equivalent for its sterling charges. The agreement was ratified by all the interested Governments on July 31st last, and brought into operation on the following day.

Monte Video Telephone Company, Limited.

The annual meeting of this company was held yesterday, at Winchester House, Mr. Herbert Ward presiding.

The Chairman said that the business had steadily increased, though the figures given in the report did not fully show the extent of the actual improvement. Lost ground to the extent of £440 had been recovered. Bad debts had been light, interest on securities was appreciably more, London office expenses were lower, and the loss on exchange was £190 less than last year. The actual cost of working expenses to earn their revenue was less than last year by £390. An important improvement had been made in the system during the year by introducing a newly-invented microphone which had proved most successful. The whole cost of this introduction was charged to maintenance. The cyclone in January caused great damage to outside work. The whole plant is now in a most complete state of efficiency. The manager in Monte Video recently stated that he believed the maintenance charges for the ensuing year would be lower, and that the next report would show a great increase in business.

The report was adopted, a dividend of 4 per cent. on the ordinary shares declared, and after the retiring directors and auditors had been re-elected, the meeting closed with the usual vote of thanks.

The Brazilian Submarine Telegraph Company, Limited.

The report of the directors and the accounts for the half-year ended June 30th, 1896, to be submitted to the forty-sixth ordinary general meeting, October 28th, 1896, states that the revenue for this period amounted to £92,071 1s. 9d. and the working expenses to £19,210 4s. 4d. After providing £3,200 for debenture interest and sinking fund, and £1,649 10s. 7d. for income-tax, there remains a balance of £68,011 6s. 10d.; to this is added the sum of £15,049 2s. 2d. brought forward from December 31st last, making a total of £83,060 9s. A quarterly interim dividend, amounting to £19,500, has been paid, and £20,000 transferred to the reserve fund. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which together will amount to £32,500, leaving a balance of £11,060 9s. to be carried forward. The dividend and bonus will be payable on the 29th inst. The receipts for the half-year include the sum of £1,500 dividend to December 31st, 1895, on the company's shares in the African Direct Telegraph Company, Limited. The directors record with profound regret the death of their highly esteemed colleague and chairman, Sir John Pender, G.C.M.G. The various sections of the company's lines are in good working order. Mr. J. Denison Pender and Mr. Frederick Youle retire at this meeting, and being eligible for re-election as directors, offer themselves accordingly. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. Gane, Jackson, Jefferys & Wells, also offer themselves for re-election.

Brush Electrical Engineering Company, Limited.

The Reduction of Capital.

A circular to the shareholders states that, for the reasons pointed out in the report recently issued to the shareholders, it has been decided to reduce the company's capital by writing off £1 from the nominal value of each of the 90,000 ordinary shares. For the benefit of those shareholders who were not present at the meetings of the company on 5th inst., the directors explain the effect of the proposed reduction in greater detail than appeared in the report. Under the constitution of the company, the holders of preference shares have a preference in dividend, but not as regards capital; and therefore, in the event of the company going into liquidation (a remote contingency), the holders of ordinary shares would be entitled to receive three-fifths, and the holders of preference shares two-fifths of any surplus assets, after payment of debentures and other debts and liabilities, and the expenses of liquidation. After the capital has been reduced in the manner proposed, the holders of preference and ordinary shares will be entitled to participate in equal shares in the assets on winding-up, and neither class of shareholders will be in any way prejudiced as regards dividend. The directors, who hold a large number of ordinary shares themselves, have, after careful consideration, decided that under all the circumstances the proposed mode of reduction is the best available, and wish to point out that, as it will facilitate payment of dividends, the holders of ordinary shares will reap the main benefit of the proposed reduction so long as the company is a going concern. A reduction of the preference capital would entail an immediate and continuing loss on the holders of preference shares, and would have the effect of transferring part of the dividend to which they are now entitled to the pockets of the holders of ordinary shares. The resolution for reduction was discussed at some length at the meeting of the company held for the purpose on 5th inst., and was eventually passed by a majority of 42 to 10. In order to obtain the sanction of the Court to the reduction, it is desirable to have as many votes as possible recorded at the meeting to be held on November 2nd.

The Hove Electric Lighting Company, Limited.—The Board, when sending out the warrants for interim dividend, state that the business of the company continues to improve satisfactorily. The number of consumers has increased to 305, and the lamps attached to the company's mains are now equivalent to 20,911 lamps of 8 C.P., while the net revenue for the half-year ending June 30th has increased by nearly 25 per cent. over the amount for the corresponding period of last year. The directors have pleasure in stating that the 5 per cent. debentures were duly paid off on July 1st, according to notice, and the loan from the company's bankers has also been extinguished. The total debentures now issued are £7,300 at 4½ per cent., and £14,600 at 4 per cent. The whole of the share capital of the company has been subscribed, the last 922 shares at a premium of 10s. per share. The reserve fund now amounts to £1,287. Considerable extensions are being made to the company's mains to meet the demands of new consumers.

The Cambridge Electric Supply Company, Limited.—Mr. John H. Barker, A.M.I.C.E., the general manager of this company, sends us the following note of the quarterly returns from July 1st to September 30th:—

	1896.	1895.
Number of units sold during quarter ...	17,025	13,027
Revenue from electricity supply ...	£467 15 10	£354 16 0
Revenue, meter rents, and other sources	62 13 9	56 0 0
	£530 9 7	£410 16 0

Stock Exchange Notice.—Application has been made to the Stock Exchange Committee to appoint a special settling day in:—Charing Cross and Strand Electricity Supply Corporation, Limited—10,000 4½ per cent. preference shares, Nos. 1 to 10,000.

West India and Panama Telegraph Company, Limited.—The directors announce, after paying the preference dividends, and placing £1,000 to reserve, the payment of a dividend of 1s. 6d. per share on the ordinary shares.

TRAFFIC RECEIPTS.

The City and South London Railway Company. The receipts for the week ending October 18th, 1896, were £1,012; week ending October 20th, 1895, £927; increase, £85; total receipts for half-year, 1896, £14,693; corresponding period, 1895, £13,701; increase, £992.

The Liverpool Overhead Railway Company. The receipts for the week ending October 18th, 1896, amounted to £1,081; corresponding week last year, £1,104; decrease, £23.

The Western and Brazilian Telegraph Company, Limited. The receipts for the week ending October 16th, 1896, after deducting 17 per cent. of the gross receipts payable to the London Platino-Brazilian Telegraph Company, Limited, were £2,849.

SHARE LIST OF ELECTRICAL COMPANIES.

TELEGRAPH AND TELEPHONE COMPANIES.

Present issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation, Oct. 14th.	Closing Quotation, Oct. 21st.	Business done during week ended Oct. 21st, 1896. Highest.	Lowest.
173,400£	African Direct Teleg., Ltd., 4 % Deb.	100	4 %	4 %	4 %	100 —104	100 —104	...	...
25,000	Amazon Telegraph, Limited, shares...	10	...	...	...	8½— 9½	8½— 9½	...	...
1,012,880£	Anglo-American Teleg., Ltd.	Stock	£2 11s.	£2 2s.	£2 9s.	50 — 53	49 — 52xd	51½	...
2,993,560£	Do. do. 6 % Pref.	Stock	£5 2s.	£4 4s.	£4 18s.	96 — 97	95 — 96xd	96	95
2,993,560£	Do. do. Defd.	Stock	...	...	...	8⅝— 9½	8⅝— 9½	9	...
130,000	Brazilian Submarine Teleg., Ltd.	10	6½% §	7 %	7 %	14⅝— 15½	14⅝— 15½	15½	14⅝
75,000£	Do. do. 5 %, Debs., 2nd series, 1906	100	5 %	5 %	5 %	112 —116	112 —116	...	...
44,000	Chili Telep., Ltd., Nos. 1 to 44,000	5	... §	2½%	4 %	3¼— 3⅝	3¼— 3⅝	...	...
10,000,000$	Commercial Cable Co.	$100	7 %	7 %	7 %	145 —150	145 —150	...	...
224,850	Consolidated Telep. Const. and Main., Ltd.	10/-	2 % §	1½%	1½%	1/16— 1/8	1/16— 1/8	...	...
16,000	Cuba Teleg., Ltd.	10	8 %	8 %	8 %	11½— 12½	11½— 12½	12½	12
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	19½	...
12,931	Direct Spanish Teleg., Ltd. ... ...‖	5	4 %	4 %	4 %	3¼— 4¼	3¼— 4¼	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	10 %	10 — 10½	10 — 10½	...	...
30,000£	Do. do. 4½ % Debs. Nos. 1 to 6,000 ...	50	...	4½%	4½%	107—110%	107 —110 %	...	...
60,710	Direct United States Cable, Ltd.	20	2⅝% §	2 %	2½%	9½— 10	9½— 9¾xd	9½	...
400,000	Eastern Teleg., Ltd., Nos. 1 to 400,000	10	6½% §	6½%	6½%	17¾— 18½	17½— 18xd	19	17½
70,000	Do. 6 % Cum. Pref.	10	6 % §	6 %	6	18½— 19½	18½— 19½xd	18 15/16	18⅝
102,100£	Do. 5 % Debs., repay. August, 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
1,297,837£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	4 %	131 —134	131 —134	132½	131
250,000	Eastern Extension, Australasia and China Teleg., Ltd. ...	10	7 %	7 %	7 %	17½— 18	17½— 18xd	18	17 11/16
54,100£	{ Do. 5 % (Aus. Gov. Sub.), Deb., 1900, red. ann. drgs. reg. 1 to 1,049, 3,976 to 4,326	}100	5 %	5 %	5 %	100 —104	100 —104	...	...
194,300£	Do. do. Bearer, 1,050—3,975 and 4,327—6,400	100	5 %	5 %	5 %	101 —104	101 —104	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	4 %	130 —133	130 —133	...	...
80,600£	{ Eastern and South African Teleg., Ltd., 5 % Mort. Deb. 1900 redeem. ann. drgs., Reg. Nos. 1 to 2,343	}100	5 %	5 %	5 %	101 —105	101 —105	...	...
107,600£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	5 %	5 %	102 —105	102 —105	...	...
800,000£	{ Do. 4 % Mort. Debs. Nos. 1 to 3,000, red. 1909	}100	4 %	4 %	4 %	106 —109	106 —109	...	...
200,000£	Do. 4 % Reg. Mt. Debs. (Mauritius Sub.) 1 to 8,000	25	4 %	4 %	4 %	110 —113 %	110 —113 %	111¾	...
180,227	Globe Telegraph and Trust, Ltd.	10	4⅝% §	4½%	4½%	10⅜— 11¼	10⅜— 11¼	11⅛	10⅞
180,042	Do. do. 6 % Pref.	10	6 % §	6 %	6 %	17½— 18	17½— 18	17⅞	17⅝
150,000	Great Northern Teleg. Company of Copenhagen	10	8⅜%	8⅜%	10 %	24 — 25	24 — 25	24¼	24⅛
180,000£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	104 —107	104 —107	...	...
17,000	Indo-European Teleg., Ltd.	25	10 %	10 %	10 %	52 — 53	52 — 55	...	...
100,000£	London Platino-Brazilian Teleg., Ltd. 6 % Debs.	100	6 %	6 %	6 %	109 —112	109 —112	...	...
28,000	Montevideo Telephone 6% Pref., Nos. 1 to 28,000... ...	5	4 %	4 %	4 %	2 — 2½	2 — 2½	...	...
484,597	National Teleph., Ltd., 1 to 484,597	5	5 % §	5 %	5¼%	7¼— 7½	7¼— 7½	7⅜	7¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	17 — 19	17 — 19	17⅞	...
119,234	Do. 5 % Non-cum. 3rd Pref., 1 to 119,234	5	5 %	5 %	5 %	6¾— 7	6¾— 7	...	...
1,100,000£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	106 —109	106 —109	...	...
171,504	Oriental Teleph. & Elec., Ltd., Nos. 1 to 171,504, fully paid	1	...	4¼%	5 %	11/16— 13/16	11/16— 13/16	...	...
100,000£	{ Pacific and European Tel., Ltd., 4 % Guar. Debs, 1 to 1,000	}100	4 %	4 %	4 %	108 — 111	108 —111	108½	...
11,839	Reuter's Ltd.	8	0 %	*nil*	5 %	7 — 8	7 — 8xd	7	...
3,381	Submarine Cables Trust	Cert.	...	...	...	138 —143	136 —141	...	...
58,000	United River Plate Teleph., Ltd.	5	...	3 %	4 %	3½— 4	3½— 4	...	...
146,733£	Do. do. 5 % Debs.	Stock	5 %	5 %	5 %	101 —106	101 —106	...	...
15,609	West African Teleg., Ltd., 7,501 to 23,109	10	*nil*	*nil*	4 %	5 — 6	5 — 6	...	...
238,360£	Do. do. do. 5 % Debs.	100	5 %	5 %	5 %	102 —105	102 —105	...	...
38,000	West Coast of America Teleg., Ltd.	10	*nil*	*nil*	*nil*	½— 1½	½— 1½	...	...
158,080£	Do. do. do. 8 % Debs., repay. 1902	100	8 %	8 %	8 %	98 —103	98 —103	...	...
54,248	Western and Brazilian Teleg., Ltd.	15	2½%	3 %	3 %	8¼— 8⅝	7⅞— 8¼	8⅛	8
33,129	Do. do. do. 5 % Pref. Ord. ...	7½	5 %	5 %	5 %	6½— 7	6½— 6⅞	7	6 15/16
33,129	Do. do. do. Def. Ord.	7½	...	1 %	1 %	2¼— 2⅜	1⅞— 2¼	...	...
165,200£	Do. do. do. 6 % Debs. "A," 1880 Red.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
206,400£	Do. do. do. do "B," do.	100	6 %	6 %	6 %	103 —107	103 —107	...	...
88,321	West India and Panama Teleg., Ltd.	10	⅞%	⅞%	⅞%	1⅛— 1⅜	1⅛— 1⅜	1¼	1 3/16
34,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11½— 12	11½— 12	11⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	9½— 10½	9½— 10½	...	...
80,000£	Do. do. 5 % Debs. No. 1 to 1,800 ...	100	5 %	5 %	5 %	108 —111	108 —111	...	...
1,777,000$	Western Union of U. S. Teleg., 7 % 1st Mort. Bonds ...	$1000	7 %	7 %	7 %	110 —115	110 —115	...	...
164,300£	Do. do. 6 % Ster. Bonds.	100	6 %	6 %	6 %	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electy. Supply	5	4½%	4½%	5 %	9½— 10	9½— 10	9⅝	...
10,277	*Chelsea Electricity Supply, Ltd., Ord., Nos. 1 to 10,277 ...	5	5 %	5 %	5 %	7¾— 8½	7¾— 8½	8⅛	8
60,000	Do. do. do. 4½ % Deb. Stock Red. ...	Stock	...	...	4½%	114 —117	114 —117	...	...
40,000	City of London Elec. Lightg. Co., Ltd., Ord. 40,001—80,000	10	...	5 %	5 %	16 — 17	16 — 17	16 13/16	16½
40,000	Do. do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	17½— 18½	17 — 18	17 13/16	17½
300,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	5 %	131 —135	131 —135	131	...
22,475	County of Lond. & Brush Prov. E. Ltg. Ltd., Ord. 1—22,475	10	...	...	*nil*	8½— 9½	8½— 9½	...	...
20,000	Do. do. do. 6% Pref., 40,001—50,000 ...	10	...	...	6 %	13¾— 14½	13¾— 14½	...	...
10,000	Do. do. do. iss. at 2 pm., all paid	10	...	...	...	5½— 6½	5½— 6½	6½	6
49,900	*Metropolitan Electric Supply, Ltd., 101 to 50,000 ...	10	2½%	3 %	4 %	12½— 13½	13 — 14xd	13½	13
12,500	Do. Ord., 50,001—62,500, iss. at £2 prem., £1 paid	10	...	...	...	3¼— 4½	3½— 4½	3 3/16	...
150,000£	Do. 4½% first mortgage debenture stock	...	4½%	4½%	4½%	121 —124	121 —124	...	...
6,452	Notting Hill Electric Lightg. Co., Ltd.	10	...	1 %	2 %	11½— 12½	11½— 12½	...	...
19,980	*St. James's & Pall Mall Elec. Light Co., Ltd., Ord., 101-20,080	5	4½%	6½%	7½%	11½— 12½	11½— 12½	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	10 — 11	10 — 11	10⅛	...
50,000	Do. do. 4 % Deb. stock Red. ...	Stock	...	...	...	106 —109	106 —109	...	...
67,900	*Westminster Electric Supply Corp., Ord., 101 to 60,000	5	4 %	5 %	7 %	10½— 11½	10½— 11½	...	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.

§ Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL, COMPANIES.

Present Issue.	NAME.	Stock or Share ‡	Dividends for the last three years. 1893.	1894.	1895.	Closing Quotation Oct. 14th.	Closing Quotation, Oct. 21st.	Business done during week ended Oct. 21st, 1896. Highest.	Lowest
£0,000	Brush Elecl. Enging. Co., Ord., 1 to 90,000...	3	5 %	2½%	...	⅞ - 1⅛	⅞ — 1⅛	15/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	6 %	3 %	...	1⅛ — 1⅜	1⅛ — 1⅜	1 5/16	...
125,000‡	Do. do. 4½ % Perp. Deb. Stock.... ...	Stock	4½%	4½%	...	110 —113	110 —113	...	...
76,770	Do. do. 4½% 2nd Deb. Stock Red. ..	Stock	...	...	...	97 —101	97 — 101	...	...
9,104	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10	...
207,649	Do. do. do. £4 paid	10	...	...	...	4½ — 4⅝	4½ — 4⅝	...	...
630,000‡	City and South London Railway	Stock	1⅛%	1½%	1 3/16%	50 — 52	50 — 52	51½	50
28,180	Crompton & Co., Ltd., 7 % Cum. Pref. Shares, 1 to 28,180	5	3 %	nil	nil	2 — 2½	2 — 2½	...	...
89,261	Edison & Swan United Elec. Lgt., Ltd., "A" shrs, £3 pd. 1 to 89,261	5	7 %	5 %	5 %	1⅞ - 2¼	1⅞ - 2¼	...	...
17,139‡	Do. do. do. "A" Shares 01—017,139	5	7 %	5 %	5 %	3 — 4	3 — 4	...	...
100,000	Do. do. do. 4½% Deb. Stock Red. ...	Stock	...	4½%	4½%	103 —106	103 —106	...	...
110,000	Electric Construction, Ltd., 1 to 110,000	2	nil	nil	5 %	1½ — 1⅝	1½ - 1⅝	...	...
12,845	Do. do. 7 % Cum. Pref., 1 to 12,845 ..	2	7 %	7 %	7 %	2½ — 3	2½ - 3	...	...
91,195	Elmore's Patent Cop. Deposg., Ltd., 1 to 70,000	2	nil	nil	...	⅜ — ⅝	⅜ — ⅝	...	...
69,385	Elmore's Wire Mfg., Ltd., 1 to 69,385, issued at 1 pm. ...	2	nil	nil	...	½ — ⅝	½ — ⅝	...	...
9,600‡	Greenwood & Batley, Ltd., 7 % Cum. Pref., 1 to 9,600 ...	10	nil	nil	10½%	10½ — 11½	10½ — 11½	...	...
10,000	Henley's (W. T.) Telegraph Works, Ltd., Ord.	10	5 %	6 %	8 %	17½ — 18½	17½ — 18½	18	...
3,000	Do. do. do. 7% Pref.	10	7 %	7 %	7 %	18½ — 19½	18½ — 19½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock	Stock	...	...	4½%	110 —115	110 —115	...	...
50,000	India-Rubber, Gutta Percha and Teleg. Works, Ltd. ...	10	(2½%	10 %	10 %	22 — 23	21½ - 22½	22½	21⅝
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	105 —108xd	105 —108	...	...
37,500 †	Liverpool Overhead Railway, Ord.	10	1 %	1½%	2½%	13 7/16 — 13 9/16	13 7/16 — 13 9/16	...	...
10,000 †	Do. do. Pref., £10 paid	10	5 %	5 %	5 %	16⅞ — 17⅜	16⅞ — 17⅜	...	...
37,350	Telegraph Constn. and Maintce., Ltd.	12	20 %	20 %	15 %	39 — 42	39 — 42	40	39
150,000	Do. do. do. 5 % Bonds, red. 1899	100	5 %	5 %	5 %	104 —107	104 —107	...	...
54,000‡	Waterloo and City Railway, Nos. 1 to 54,000, £6 paid ...	10	...	...	...	7⅞ — 8¼	7⅞ — 8¼	7⅞	7¾

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid. ¶ Last dividend paid was 50% for 1890.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.
Crompton & Co.—The dividends paid on the ordinary shares (which have not a Stock Exchange quotation), are as follows: 1892—0%; 1891—7%; 1890—8%

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

* Birmingham Electric Supply Company, Ordinary of £5 (£4 paid), 7, £5 (fully paid), 9⅝.
Electric Construction Corporation, 6 % Debentures, 104—107.
House-to-House Company (£5 paid), 4—4½.
Do. do. 7 % Preference, of £5, 8½—9.
Do. do. 4½% Debentures of £100, 109 - 112.
Kensington and Knightsbridge Electric Lighting Company, Limited, Ordinary Shares £5 (fully paid) 10—10½; 1st Preference Cumulative 6 %, £5 (fully paid), 8½—8⅝.
London Electric Supply Corporation, £5 Ordinary, ¾—1¼.
Yorkshire House-to-House Electricity Company, £5 Ordinary Shares fully paid, 7½—8.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (September 24th 1896).

MAGNETISING CURRENT IN TRANSFORMERS.

Some engineers take the amount of magnetising current as a measure of transformers, and imagine that the lower this current, the less the losses in transformers; but this is not so in fact, for two transformers may show the same magnetising current, and yet the losses in one may be double the losses in the core of the other.

The following table of results of tests on 10 1,500-watt transformers, tested on 1,000-volt circuit, at a frequency of 125, brings out the fact that core losses and magnetising current are not related to each other by any strict law:—

Core Losses and Exciting Current.

	Core loss. A.	Exciting current. B.	Ratio. A./B.
1	26·5	·043	620
2	32·2	·052	620
3	35·	·055	636
4	43·2	·077	560
5	45·7	·054	850
6	50·5	·076	666
7	57·5	·073	790
8	95·	·200	475
9	120·	·300	400
10	126·	·173	720

The ratio column in the table shows plainly that there is no fixed relation between the amount of power wasted in the transformer core and the exciting current ("leakage current"), and the relative magnitude of the quantities in columns A and B are still more instructive to the central station man who thinks "leakage current" is the proper criterion to be used for the comparison of transformers. It chances that the transformers with the lowest leakage currents of the table are from the same manufacturer, and have the least core losses; but there is a difference between leakage currents of Nos. 4 and 5 of the table of over 40 per cent. in favour of No. 5, though No. 4 has a slightly less core loss, and there is practically no choice between the exciting currents of Nos. 4, 6 and 7, though there is over 30 per cent. difference in their core losses. Again, there is practically no difference in the exciting currents of Nos. 2, 3 and 5, though there is a difference of over 40 per cent. in their core losses.

Prof. Jackson, who gives these figures in the *American Electrician*, advocates the thorough testing of transformers by the Wattmeter methods, and gives a table of data for the guidance of those who may require to make tests in selecting transformers. The second column is from data compiled by Prof. Ryan, and gives the largest current which should flow in the 1,000-volt primary of good transformers when the secondary circuit is open. For intermediate capacities, intermediate values of open circuit current may be interpolated. The third column gives the values of the iron loss which should not be exceeded in thoroughly good transformers:—

Transformer Data.

Watts capacity.	Open circuit currents.	Iron loss.
1,000	·055	30
1,500		40
2,000	·080	50
2,500		60
4,000		80
6,500	·100	100
17,500	·200	150

The copper losses in all sizes of transformers should never exceed 3½ per cent. at full load, and ought to be between 1 and 1½ per cent. The total drop in secondary pressure due to loading a transformer, if the primary pressure is kept constant, ought not to exceed 3½ per cent.

How these figures agree with transformers on this side is not easily discovered, unless some of the users of transformers with reliable tests can compare them. According to the claims of some manufacturers, we can do quite as well as these tests show, if not better.

BATTERY WITH CARBON ELECTRODES (WITHOUT METAL).

Last summer various special publications celebrated the invention, by Dr. A. Coehn, of a battery in which the negative soluble electrode, instead of being metal, is formed of carbon.*

Now, Mr. Coehn has really no other merit than that of having had, after twelve years' delay, the idea that another inventor had had and realised before him.

In short, a battery identical with the one Mr. Coehn claims to have invented was presented by Dr. D. Tommasi to the Académie des Sciences of Paris in June, 1884.

This battery, which was constructed by M. Radiguet, and placed before the public under the name of *a battery with carbon electrodes* (*without metal*), was brought out in two types, the description of which was given by the inventor, Dr. Tommasi, on page 308 of his "Traité des Piles" (edited by Carré, Paris), the first being rectangular, the second cylindrical. This is briefly the description of the second type :—

In the centre of a cylindrical glass vessel is placed a rod of carbon, covered with a thick layer of peroxide of lead, and enclosed in a cloth bag.

This electrode, thus encased, is placed in a perforated tube of carbon ; the whole arrangement occupies the centre of the glass vessel, which is filled up with fragments of retort carbon, and half way with a concentrated solution of chloride of sodium, to which is added some chloride of calcium, this latter being eminently hygrometric, and thus preventing, or at any rate greatly retarding, the evaporation of the water.

The fragments of carbon that are not immersed in the liquid are covered with a layer of chloride of calcium. We may add that this battery was exhibited in the same year, 1885, at the Easter reunion of the French Physical Society, when, by the absence of metal of any kind, it puzzled many specialists.

At this time the heat of formation of peroxide of lead was not known. It was not until a later, when Tschelzou had found out that the passing of one molecule of protoxide of lead into the state of peroxide disengages 12·14 calories, that Dr. D. Tommasi was able to give the theory of his battery with carbon electrodes.†

It will, perhaps, not be superfluous to reproduce it. The heat of formation of anhydrous protoxide of lead (P C O) being 51 cal., the heat of formation of the peroxide ($PC O^2$) is 63·14 cal.

Considering the action exercised by carbon on water,‡ we can explain in the following manner what takes places in the glass vessel of the battery.

The carbon decomposing the water in a closed circuit, carbonic acid would be formed, and hydrogen would be disengaged according to the equation,

$$C + 2 H^2 O = C O^2 + 4 H.$$

The thermic effects of this reaction are :

$$102{\cdot}6 \text{ cal.} - 138 \text{ cal.} = -35{\cdot}4 \text{ cal.}$$

Moreover, in the bag which acts as a porous envelope there would be a reduction of the peroxide of lead and a formation of water, according to the equation,

$$P C O^2 + 4 H = P C + 2 H^2 O,$$

and the thermic effect of this reaction would be

$$138 \text{ cal.} - 63{\cdot}14 \text{ cal.} = 74{\cdot}86 \text{ cal.}$$

The heat resulting from these two reactions is the algebraical sum of their thermic effects, or

$$74{\cdot}86 \text{ cal.} - 35{\cdot}40 \text{ cal.} = 39{\cdot}46 \text{ cal.}$$

The volt corresponding, according to certain writers, to 46·3 cal., the electromotive force of the battery with carbon electrodes would be :

$$39{\cdot}46 : 46{\cdot}3 = {\cdot}85 \text{ volt.}$$

If we reckon the volt at 47·16 cal., which is the value accepted by some writers, we get

$$39{\cdot}46 : 47{\cdot}16 = {\cdot}84 \text{ volt.}$$

Direct measurements gave ·6 to ·7 of a volt.

We can easily explain this difference when we consider that the battery is easily polarised, and that, besides carbonic acid, oxide of carbon may be formed, which would tend to diminish the heat produced by the first reaction, that secondary reactions may be set up, and lastly, that these phenomena are certainly influenced by the temperature, the degree of purity of the substances used, &c.*

* *L'Electricien*, July 25th, 1896.

† *Moniteur Industriel*, 1885, and *Bulletin* de la Société Chimique de Paris, 1887, Vol. i., p. 86.

‡ Dr. D. Tommasi, "Electrolysis of Water with Electrodes of Different Natures" (*Comptes Rendus* of the Academie des Sciences, Paris, 1881).

THE INSTITUTION OF JUNIOR ENGINEERS.

Scottish Summer Meeting.

(*Concluded from page* 500.)

On Wednesday morning, dividing into two sections, one visited Messrs. James White's instrument factory, and Messrs. Neilson's locomotive works ; the other going to the new Howe Machine Company's works, and the Glasgow hydraulic power supply pumping station. At Messrs. White's works, where over 200 operatives are employed, perhaps the most important work carried on is the manufacture of the whole series of Lord Kelvin's electrical instruments, comprising the standard balances, inspectional instruments for central stations, and electric supply meters. At a recent extension the Kelvin laboratory was added to the works. It is fitted with all the instruments and apparatus necessary for carrying on the standardising department of the business. Much interest was also evinced in the Barr and Stroud range finders, likewise made here. Professor A. Barr, the joint inventor, and who, by the way, is an honorary member of the Institution, was present, and assisted in explaining the various instruments.

At Messrs. Neilson and Co.'s locomotive works, which are the largest of the kind in Great Britain, Mr. Hugh Reid showed the members over. The firm was founded in 1837, being situated originally in Hyde Park Street, close to the harbour, but in 1862 they were removed to their present site at Springburn. As an indication of the growth of these works it may be stated that in 1865 about 1,000 men were employed, and the output was 82 engines. In 1885 and 1886 over 200 engines were turned out each year with 2,500 men, and when the extensive alterations and additions at present being carried out are completed, the firm will be able to give employment to over 3,000 men, and the capacity of the establishment should be over 250 engines and tenders per annum. The total output to the present time amounts to more than 5,000 engines. The excellent arrangement of the shops was especially noticed, the various departments being placed with a view to the regular sequence of work being followed throughout. The pattern shop leads to the brass and iron foundries and coppersmiths' shop, the template shop, and the boiler and tender shops, parallel to which are the smithy and forge.

It would seem that whatever the condition of other branches of the engineering trade may be, the cycle makers will continue merrily going for some considerable time to come. The governing spirits of the New Howe Works have directed preparations to be made for doubling their output, at present 500 machines per week. The buildings, which were originally erected by the Howe Sewing Machine Company, cover an area of 6,500 square feet. The main building is five storeys high, and is equipped with machinery for the manufacture of cycles. A pair of horizontal Corliss engines supply power to

* For further details see Dr. Tommasi's "Traité Théorique et Pratique d'Electrochemie, p. 515 (edited by Bernard, Paris).

the machine shop; 24-inch cylinders and 4 feet stroke. Steam at a pressure of 70 lbs. per square inch is obtained from three Lancashire boilers.

The hydraulic power pumping station at the corner of High Street and Rotten Row occupies a site triangular in shape, and has been divided into two, forming a low level and a high level yard, one being 16 feet higher than the other. The buildings are substantially erected in the Scottish baronial style of architecture, and designed for containing six sets of pumping engines, and eight boilers, only half of which are as yet put in. The engines are of the marine type, inverted, direct-acting, triple-expansion, surface condensing, and steam jacketed. The cylinders are 15, 22, and 36 inches diameter, with 2 feet stroke. The three main pumps on each engine are single acting, with rams 4½ inches diameter and 2 feet stroke. They are driven direct from the engine cross-heads. Each engine pumps 150,000 gallons of water in 10 hours against a pressure of 1,120 lbs. per square inch, with steam at 150 lbs. per square inch. The boilers are Lancashire, made of mild steel plates, 30 feet long and 7 feet diameter, with two flues 2¾ feet diameter in each. Vicars mechanical stokers are fitted; a Watmun automatic water-circulator is connected to each boiler, and Green's economisers are placed in the main flue. There are two accumulators, having cast iron cylinders and rams 18 inches diameter and 23 feet stroke. The load consists of ironstone slag.

The members assembled at 2 o'clock in the Municipal Buildings, Glasgow, where, on the invitation of the Lord Provost, magistrates and Town Council, they were entertained to a reception and luncheon. The senior magistrate, Bailie Pettigrew, presided, and the company included Sir William Arrol, Professors Barr, Mathieson, and Watkinson, and Mr. A. S. Biggart. In the toast-list, which was afterwards dealt with, after the usual loyal expressions, "Both Houses of Parliament" was proposed by Bailie Wilson, Sir W. Arrol responding. To "The Institution of Junior Engineers," given by the chairman, the President replied. Bailie Chisholm then proposed "Lord Kelvin, Vice-President of the Institution," which in his unavoidable absence was responded to by his colleague, Prof. A. Barr. At the conclusion of the luncheon the party were photographed in the quadrangle, and afterwards train was taken to Milngavie to inspect the new Craigmaddie reservoir of the Glasgow Corporation waterworks, the principal source of supply being from Loch Katrine, in Perthshire, about 30 miles north of Glasgow. The Act of Parliament for the construction of the first works was obtained in 1855; they were completed in 1859, the quantity of water made available being sufficient to maintain a supply of 50 million gallons per day for Glasgow, and 40½ million gallons per day for compensation to the River Teith. The aqueduct from the loch is 25⅝ miles long, and discharges into the Mugduck reservoir, about 7 miles from Glasgow. This reservoir is 317 feet above the sea level, and has a water surface of 60 acres; its depth when full is 50 feet, and its contents 548 million gallons, or about 11 days' supply. From the reservoir the water is drawn into a circular well cut out of the rock, 40 feet diameter and 63 feet deep, fitted with copper wire-cloth strainers. Through these the water passes into two lines of 42-inch pipes, laid in a tunnel 420 yards long, and then by four lines of 36-inch pipes to the city. These original works cost £1,330,000.

In 1882, owing to the increasing demands for water, an Act was obtained for the construction of an additional service reservoir adjoining the Mugduck, and in 1885 a further Act was granted which gave power to duplicate the aqueduct, to raise Loch Katrine water level 5 feet higher, and to convert Loch Arklet into a reservoir by raising its water level 25 feet. These new works were designed with a view of an ultimate supply to the city of 100 million gallons per day. The new Craigmaddie reservoir will have a water surface of 86¼ acres, and will contain 700 million gallons, or 14 days' supply to the city, at 50 million gallons per diem. The combined capacity of both reservoirs will be 12½ days' supply, at the rate of 100 million gallons per day. The new works were commenced in 1883, and the reservoir was opened in June last. The distinguishing feature in its construction was the puddle trench, which had to be sunk to a depth of 193 feet, proving so costly, that £74,000 had to be spent upon it. The necessity of sinking this trench was quite unexpected, and the completion of the reservoir was delayed so much thereby, that in 1892 the Act had to be extended for an additional five years. Altogether there are 293,760 cubic yards of puddle in the embankment, 598,750 cubic yards of ordinary earthwork, and 44,000 cubic yards of stone facing. The cost of the reservoir, including land, but exclusive of interest, has been about £300,000.

Under whatever circumstances a party of visitors may be congregated at Glasgow, a trip on the Clyde is probably well nigh inevitable, and a glimpse of the magnificent scenery thus rendered possible, fully justifies any executive in arranging this excursion. The Junior Engineers were particularly fortunate in this connection, for their president, Mr. A. Denny, most generously placed at the service of the Institution, his smart steam yacht *Snark*, which is provided with quadruple expansion engines, and well appointed in every particular. The party got aboard at Craigendoran, Mr. Denny accompanying the members. The route was through the Kyles of Bute, with an hour ashore at Colintraive for luncheon. In the afternoon, under the awning forward, where a piano had been installed, a concert programme was soon arranged and carried through. Returning to Craigendoran, train was there waiting at the pier to convey the party back to Glasgow, everybody having spent a highly enjoyable day, the president's geniality and kindness throughout calling forth many appreciative expressions.

Two sections were again formed on Friday morning, one going to the Wishaw Works of the Glasgow Iron and Steel Company, whilst the other proceeded to the Singer Sewing Machine Works at Kilbowie. At Wishaw Mr. James Riley received the members. The premises extend to over 40 acres, the productions being hematite iron for use in steel works; ordinary Scotch pig iron; ammonia and tar from the waste gases; and Bessemer, Siemens, or Siemens-Martin steel. There are four blast furnaces, two being 72 feet high, and the others 67 feet; their combined output is from 6,000 to 7,000 tons per month. Three Ford and Moncur heating stoves, 70 feet high and 26 feet diameter, are used for heating the blast. Three blowing engines are employed, the working pressure of the blast being about 6 lbs. per square inch. In the steel works there are three Bessemer converters with blowing engines capable of producing a pressure of 25 lbs. to the square inch. For the manufacture of Siemens steel nine furnaces are provided; six of 35-ton and three of 50-ton per charge, and another furnace is being erected. The rolling mills contain some very fine machinery of the most modern description; on one side of the mill floor was noticed an annealing furnace capable of taking in a plate 40 feet × 11 feet. The entire works are lighted by electricity. After luncheon, by invitation of the company, some of the members went on to Messrs. R. V. Pickering's works, where most complete preparations had been made to show the various processes involved in the manufacture of railway waggons and wheel making. The spoke bending appliances, the 1,000-ton hydraulic press used for forming hydraulic pressed wrought-iron bosses, and the forging press, were seen in operation. Electricity is the illuminant at these works, the current being generated on the premises.

Those members selecting the Singer works were well repaid by their visit. The gigantic establishment abounds with interesting and ingenious machinery; 10,000 sewing machines per week is its output. Motive power is supplied by a number of engines, collectively of about 1,900 I.H.P., steam being raised by Babcock & Wilcox boilers, capable of giving 2,350 horse-power. The main structure is fireproof, and consists of two parallel buildings, 75 feet apart, and 800 feet long; these are connected by three wings, 50 feet wide, and are three storeys high, except for about 400 feet in the centre, where there are four storeys. About 6,000 people are employed. There are about 50 different classes of machines produced, subdivided into about 300 varieties for meeting special requirements, from the sewing of fabrics almost as fine and soft as gossamer, to heavy sails or large factory belts 10 feet wide.

On Friday afternoon the Caledonian Railway Locomotive Works, and the Fairfield Shipbuilding and Engineering Works were visited. The former, round which the members were shown by the locomotive superintendent, Mr. John F. M'Intosh, occupies about 23 acres, the buildings alone covering 12 acres. Employment is given to upwards of 2,900 men in the works, and nearly an equal number in the running department. The works were entirely constructed about 10

years ago for building and repairing all descriptions of railway rolling stock, care being taken to minimise manual labour in every detail. The locomotive erecting shop can hold 80 engines and 15 tenders, and is fitted with six 30-ton overhead cranes, driven by rope gearing. The rolling stock comprises 732 engines, 1,884 carriages, and 56,036 waggons. The gross number of engines built, rebuilt, renewed, and repaired annually, is over 900, carriages over 6,000, and waggons over 63,000.

The Fairfield Works at Govan date from 1834. They have developed to such an extent that at the present time about 5,000 hands are employed. The first vessel built was the *Macgregor Laird*, of 966 tons and 200 I.H.P. for the African Royal Mail Company. Amongst the latest constructed are those for the Cunard line, the *Campania* and the *Lucania*. The works cover 50 acres, and comprise shipyard, boiler works, engine works, and tidal basin. In the shipyard are the usual bending and levelling rolls, punching and shearing machines, &c. A Brush machine supplies current to the 18 2,000-candle-power lamps used in lighting the shop here, and the ships in progress. The main building of the engine works is about 300 feet square, divided into four bays, with two-storey galleries for small tools between each. The smithy is 300 feet long × 100 feet wide, having 40 fires and 8 steam hammers. Tweddell's system of hydraulic flanging, &c., is in use, the water pressure being 800 lbs. per square inch. The vertical plate-bending rolls are capable of bending cold, steel plates 1½ inch thick and 12½ feet wide. Other special machines include a planing machine, which will admit 8 feet square under the cross slide, and will take a cut 20 feet long; a treble-geared face-lathe, which will turn 22 feet in diameter, and a screw-cutting lathe 41½ feet long.

The summer dinner of the Institution was held in the evening at the Alexandra Hotel, Glasgow, the President in the chair. The occasion was rendered especially interesting from the fact that Lord Kelvin was present as the principal guest, and responded to the toast of "The University of Glasgow," proposed by Mr. Denny. Sir William Arrol, in acknowledging the toast of "The Institution of Engineers and Shipbuilders in Scotland," proposed by Mr. W. B. Clarke, related some reminiscences of his experience during the erection of the Forth Bridge, and stated that in all his work he made it a rule never to leave anything whatever to chance. Mr. H. B. Vorley submitted the toast of "Industrial Scotland," to which Mr. James Riley replied, and "The Institution of Junior Engineers," given by the Provost of Dumbarton, was responded to by Mr. H. J. Young. The concluding toast was "The President," proposed by Mr. A. Anstruther Thomson. During the evening the members attending the meeting, in order to show their appreciation of the secretary's energies in arranging and conducting the excursion, presented him with a framed engraving of one of Lord Leighton's paintings. Mr. W. T. Dunn having thanked the party, the proceedings were brought to a conclusion with "Auld Lang Syne."

Saturday was devoted to visiting the Glasgow gas works at Dawsholm, and the sewage works at Dalmarnock, both belonging to the Corporation; Messrs. Sir W. Arrol's works were also seen. The total production of gas at Dawsholm is now 13 million cubic feet per day of 24 hours. With the other works at Tradeston and Dalmarnock, a total make of 27 million cubic feet is obtained. To Mr. Foulis, the general manager, who met the members, the successful development of the works is due. Notwithstanding the extensive adoption of the electric light with the starting of the Corporation central station, the consumption of gas has gone on steadily increasing, last year's make being 4,525,265,500 cubic feet, the price charged being 2s. 6d. per 1,000 cubic feet. Coal breaking, conveying, charging and withdrawing, is all done by machinery, Foulis-Arrol machines being employed. The saving effected by their use, as compared with hand labour, is very considerable. It is calculated that when all the Glasgow works are so fitted, the saving will be quite £25,000 per annum.

The sewage purification works, covering 19 acres, were opened in 1894, their arrangement conforming to the generally accepted and most modern ideas of efficient design. The main sewer, 7½ feet diameter, is led into the entrance chamber, which is 17 feet long × 9 feet wide and 16 feet deep, and situated at the north-west corner of the precipitation tanks. After passing through screens, the sewage flows into two catchpits, each 48 feet long × 20 feet broad. The solid matter is pushed forward, by a screw conveyor, to the elevator trough, and thence raised into a railway waggon on the floor level; the sewage, free of heavy matter, then flows into a 10 feet channel leading to the pump well, from which it is raised into a 3¾ feet cast-iron pipe, and thence flows into the mixing pit, where chemicals are introduced. The mixed liquid then passes to the precipitation tanks, of which there are 12, each holding 81,000 gallons. The sludge from these tanks is brought into the works by a 6½ feet channel. Sludge presses are provided, each, when charged, holding 25 cwts. of sludge cake, which is dropped through shoots in the floor into railway waggons. Precipitation takes 45 minutes; then floating arms are lowered to draw off the clearer water, which passes across ærating beds. The effluent water, after filtration, passes into the River Clyde. The land for the works cost £38,000, and the buildings, tanks and machinery, £67,000. Mr. Thomas Melvin is the manager.

At Messrs. Arrol's works were seen in course of construction various bridges, including the North Bridge, Edinburgh. A large number of hydraulic gas stoking plants were also in hand. Pumping engines, accumulators, hydraulic riveting machines, and other classes of work were also noticed.

Messrs. Mavor & Coulson's electrical engineering works were visited by some of the members. The work carried on here consists of the manufacture of dynamos and motors of all classes, both for lighting and transmission of power, switchboards, and all general electrical appliances. The specialites are short air space dynamos, with self-regulating armatures, and appliances for the firm's concentric system of wiring, in which the positive wire is entirely surrounded by a negative conductor, whether for switches, fuses, or cables.

The meeting concluded at 1 p.m. on Saturday, August 22nd. The Institution must have considerably enlarged its circle of Scottish friends during the week. Throughout the proceedings repeated evidences of kindness and good feeling were to be observed, and the character of the receptions extended indicate that the Association must be attaining amongst similar organisations a position of increasing importance.

REVIEWS.

Magnetism and Electricity. By W. Jerome Harrison, F.G.S. Thos. Nelson & Sons: London, Edinburgh and New York.

Mr. Harrison is chief science demonstrator to the Birmingham School Board, and from this, and the commendably low price at which his book is published, it may be concluded that the latter enjoys a wide perusal among young readers. The book is stated to be "specially adapted to the requirements of the new code," and is therefore ostensibly intended primarily for use in Board and similar schools. In his preface the author mentions that "each and every chapter of this book has been given as an object lesson many times to classes of children averaging 60 in number, and of ages from 10 to 16." Now as the work comprises some 283 pages, it would be interesting to know how long the average scholar takes to acquire an intelligent conception of the subject as presented therein. Students of the class referred to have many other matters to attend to besides electricity and magnetism, and the conclusion is that the book is too unwieldy for its purpose. Its size would be a minor drawback were the space between its covers utilised to good purpose; but this cannot be said to be the case, for the book is far from being up-to-date, as every new edition of an electrical book should be; indeed, to render it so, it would be necessary to expunge a very considerable portion of the matter, and not a few of the illustrations, many of which represent apparatus that should now only be found in museums or lumber shops.

The work is divided into three portions:—Magnetism, "Frictional" Electricity, and "Voltaic" Electricity. The former is by far the best treated of the three, even though the author does touch upon a two-fluid theory of magnetism! The idea of the magnetic circuit and lines of force receives little or no attention!; the need of this being especially

noticeable in the section on magnetic induction, where "action at a distance" is spoken of.

The author thinks :—"It seems clear that there must be two kinds of electricity." Later on, we find :—"This one-fluid theory of Franklin's has not been adopted generally by electricians"! Of course it is too much to expect any allusion to Ayrton and Perry's improvements in the gold-leaf electroscope, and in insulating stands; and there are enough exposed (glass) legs in the illustrations to surprise even a music hall *habitué*. The illustration of Biot's (Cavendish's ?) experiment shows the common fault of having the hemispheres just large enough to enclose the ball. It is impossible to perform the experiment successfully with such as these, for in separating the hemispheres some of the charge is almost certain to go back to the ball. Full descriptions are given of the cylinder and plate electrical machines, while influence machines are dismissed with four lines, and an old illustration of the Holtz apparatus!

In Part III., the reader is introduced to various "kinds" of electricity—voltaic, galvanic, dynamic, contact, and chemical. In Sec. 3 we read :—"As there are certainly two kinds of electricity, we must not think of it as one fluid but as two"; and later (Sec. 7), "Whether we produce electricity by friction, or by contact, or by chemical action, it is the same force—the same two electrical fluids are obtained." Again (Sec. 12) : "When the connecting wire is properly tested, a current of + electricity is found to flow along it from the copper pole to the zinc; while an equal current of − electricity flows along the wire at the same time; but, in the contrary direction, from the zinc pole to the copper"!!! Comment on these extracts would be superfluous.

Long descriptions are given of such little used cells as the Smee, bottle bichromate, Bunsen, and Grove, and fig. 14 represents the electric arc being produced by current from a battery of simple cells, or what is very like one. The "voltaic pile" and "couronne des tasses" also have full attention; but, apparently, not a word is said about secondary batteries. Further on come Ampère's swimming man rules. What a comical wriggling effect it must have on a large class to require them to deduce, say, the direction of a current from the observed movement of a magnetic needle.

The section on the telegraph is heartrending. Fig. 36 shows, or is supposed to show, a single-current Morse circuit, with single-needle dials where there should be sounders; and fig. 37 represents a double-needle instrument about 8 feet high, with not a word in the text to prevent the reader supposing that such are used now. Throughout the whole of Part III. there is little or no reference to lines of force and the magnetic circuit, just as is the case with Part I. The term induction is used indiscriminately for electrostatic, magnetic, and electro-magnetic effects, and it is defined as "action at a distance"! The dynamo is, apparently, far too novel, or too unimportant an apparatus to merit extended notice, for it is dismissed in six lines.

It is deplorable to think of the number of embryo electrical workers who are occupying their minds and time with such books as these, and to imagine how they will be able to apply the already old-fashioned ideas they are now absorbing when they enter on practical work—say five or six years hence.

W. P. M.

The Principles of the Transformer. Frederick Bedell, Ph. D. London and New York: Macmillan & Co.

This work is partly the production of Mr. A. C. Crehore, although completed and put into book form by Mr. Bedell; its aim is to meet the desire for a united and logical exposition of the principles involved in the action and construction of alternating current transformers. This the work carries out most fully by a systematic geometrical treatment and a general analytical treatment. It is a work to be recommended to the higher class of students for a thorough knowledge of the principles and theories of the transformers for alternating current. After a brief description of the various distribution systems employing transformers, Chapter III. deals in the orthodox method with the magnetic circuit, induction, self-induction, and mutual induction. Chapter IV. deals with the alternator and the alternating current in a general way, illustrated by a Westinghouse alternator; then follows the more original and valuable part of the work in 200 pages.

In Chapter XV. the design and construction of transformers is touched upon. However, in a work of this kind it was scarcely necessary to recount the evolution of the transformer from Faraday downwards; there are considerable differences of opinion as to the true history of the invention of the transformer, and hence the statements of the author on these points can be taken only as his views on the historical part of the subject. Also, in the history of alternators, radial poles were constructed for alternating magnets long before 1885. It is a pity that in a work, the greater part of which deals in the exact sciences of geometry and mathematics, that any claims whatever should be made for one or more inventors over all others who have helped along the progress of electrical engineering, without the most convincing proofs of his statements.

While it is easy to treat the transformer analytically in theory, and quite an interesting exercise to construct graphic diagrams by the score, illustrating the principles, the author admits that, after all that, "The complete analytical treatment of transformer design is extremely difficult, if not impossible," that is, when we come to design a commercial transformer, instead of a mathematical one.

The common transformer of commerce is, after all, designed from knowledge acquired by the old process of trial and error, or by knowledge acquired by taking a number of existing transformers, testing and tabulating results, and drawing conclusions therefrom. The theories and principles, as given by mathematical analysis, are of very little use to the constructor of transformers, as in dynamo designing. It is a compromise all through, the details are determined from the designer's experience and knowledge of former trials and errors.

On the whole, the work is very interesting and instructive, the style is very clear, and the various theories impartially examined, some good experimental diagrams are given, also some useful information on testing transformers.

INTERNATIONAL TELEGRAPH CONFERENCE AT BUDA PESTH.

[*Translated from the Journal Télégraphique, September*, 1896.]

(*Continued from page* 314.)

A new paragraph has been added to Article 13, the first part of which determines the order in which the territorial indication necessary to locate the office of destination shall appear after the name of such office.

The second part prescribes the necessity of adding the name of the country in all cases when the name of the office of destination is not shown in the official nomenclature.

These additions have been made in order to provide uniformity of treatment in all countries, and also to prevent doubt as to the route of, and charges upon, telegrams when offices have no authentic information.

The next article provides for the sending of telegrams without text. It has hitherto been left to administrations to accept or reject such telegrams.

State and Service Telegrams.

Article 16.—In this, Articles 6 and 7 have been reproduced, in so far as they refer to State telegrams.

In the following article, an addition has been made to Paragraph 6, concerning the use of code or cipher in service telegrams.

The limit of time of 72 hours provided by Article 18 for inquiries as to telegrams in course of transmission or already sent, has been confirmed, but Sundays are not calculated in this time limit.

Indications S T and S R have been adopted to establish a complete distinction between service telegrams, the charges of which do, and those of which the charges do not appear in accounts. These distinctions have necessitated a corresponding modification of Paragraphs 3 and 9 of Article 18. Paragraphs 6 and 7 of Article 18 have been transferred to Article 70, which treats of refunds.

A change made in Paragraph 5 of the same article makes an important concession to senders, as they are granted without reserve a refund of all charges paid for service advices which have been necessary on account of service errors. Such refunds in the past have not been granted, unless the original telegram was deposited for comparison.

Counting of Words.

Article 20 has been modified, and it provides a maximum and uniform length of words and groups of figures for the European and extra European system. The maximum is fixed for both systems at 15 letters for plain and 10 for code language. Figures are counted at the rate of 5 per word.

The same article provides for a liberal interpretation in the application of rules referring to the charging of addresses of telegrams.

It is provided that the name of the office of destination, followed for the purpose of completion by that of the country or the territorial sub-division, is counted as one word only, if it appears in the

first column of the official nomenclature. This innovation has been made in view of cases where the addition of the name of the country or the territorial sub-division is necessary to distinguish one office from another of the same name.

Tariffs and Charges.

As we have already announced in our article of last month, the propositions which have been made in view of a unification of European rates have not met with the success it had been hoped for, and we have indicated briefly the motives which induced the conference to postpone the discussion of these projects to the next conference, which will take place in London in 1901.

We will not revert to the question, but we think, however, we are able to give an idea of the different projects which have been submitted to the Conference, in view of a reform of the European system tariff. The most important of the propositions was that which the German Administration had presented at Paris in 1890, and upon which the Bureau International had been requested to consult interested offices, and submit results at the next Conference.

The chief points of the German proposals were:—

1. Rates between countries (limitrophe) to be 12½ centimes per word.
2. Rate between other countries 20 centimes per word.
3. Optional additional rate of 10 centimes per word for countries of great extent, or those where the maintenance of the system was unprofitable.
4. Each administration to retain terminal rates collected by them.
5. An allowance of 50 centimes to the Administration (limitrophe) for each telegram coming from or in transit over the territory of one or more administrations.
6. Calculation of the amount of transit rates on the basis of a total for one working day per month.

To carry out the work which had been entrusted to them, the Bureau International submitted the aforementioned proposals to a thorough examination.

The result was communicated to the offices interested, and the following conclusions were arrived at. The parts in italics differ from those of the German project:—

A.—Rates.

1. The rate between countries (limitrophe) to be 12½ centimes per word.
2. The rate between other countries of the European system "25 centimes" per word.
3. "The minimum charge for any telegram must not be less than 1 franc."
4. Administrations who declare they have extraordinary expenses in connection with their telegraphic system by reason of the great extent, or of the heavy cost for maintenance, "or by reason of other such causes," are authorised to collect an additional rate of 10 centimes per word.
5. "The additional rate is only chargeable on telegrams emanating from such countries referred to in the preceding paragraph, but not on telegrams addressed to such countries."

B.—Deductions.

1. Terminal rates are not subject to any deductions. Each Administration keeps the whole of the sum it collects, but it is, however, liable for the transit rates enumerated here below.
2. Each administration which transmits telegrams to another Administration for re-transmission to distant countries, grants to such Administration (limitrophe) a transit rate of "1 franc" for each telegram.
3. The amount of transit charges is not collected on each telegram, but an account is presented on the basis of a total for one working day "on the 15th of each month."

"If the 15th is a Sunday holiday, or is followed by holidays, it is to be presented on the first working day after the 15th."

The number of telegrams to be taken into account is established by multiplying the total of one working day per month by 27.

4. All submarine cables joining two distant countries may claim the same transit charges as a country.

If, however, an administration owning a line transmits a telegram to another country by a submarine cable as above described, the transit rate must be paid to the administration or the company which works the cable.

Although these two propositions, indentical in principle, have not realised the ideal of a uniform tariff, they at least do so in part. But the pecuniary sacrifices to several administrations which their introduction would bring about, as well as the losses resulting therefrom to the companies, have hindered their adoption.

It is the opinion of those in favour of this project that the sacrifices and losses would be in the end compensated by an augmentation of traffic resulting from the reduction of rates. Our sympathy for a unification of rates makes us hope for a like result, but we cannot refrain from remarking that experience does not justify such a favourable result.

We are not at all convinced that reductions of rates would result in an increase of traffic, especially when made on the European system, which are already moderate; but, on the contrary, an increase of traffic is caused by economic and political situations of States.

An increase in the number of telegrams is due to a reduction of tariffs made when great activity exists in industry, commerce, and finance, or during a very agitated political situation.

Reductions of tariffs in other cases almost always result in losses of revenue, at least during the first years of their operation.

It is also said that reductions of rates produce an increase of traffic, because they put the telegraph within reach of everybody.

The poorer classes, with few exceptions, by reason of their occupation and mode of living, have no need to correspond by telegraph, and the post suffices for all their needs. Therefore the effects of reductions are not at all as certain as they seem to be.

We shall be pardoned this digression, but we have thought it wise to again emphasise the reasons which have induced several Administrations to declare themselves opposed to the immediate adoption of the propositions of the German Administration, and of the Bureau International.

The French Administration has also tried to settle this problem by proposing a fixed and uniform tax of 50 centimes per telegram, independent of the number of words it contains, and to this should be added a tax per word, variable as to the nature of the countries of destination, and the number of countries traversed.

For simplification of accounts the fixed rate should be excluded, and should belong entirely to the office which collects it.

The same project provides for the equalisation of terminal and transit rates of each country, 6 centimes per word for large countries, and 4 centimes for others.

Lastly, the amount to be paid to each office should be calculated, on the basis of the average for two working days of each month.

Financial considerations have caused the German tariff project (and as amended by the Bureau International) to be deferred till the next conference, as well as the French proposition.

The Belgian proposition was at the same time also deferred. It was afterwards supported by the Bulgarian delegation. This project proposed a reform of tariffs in the nature of a new division of taxes between large and small states. The conference adjourned this project for the purpose of enabling administrations to fully consider the subject.

The following is the substance of the Resolution for the adjournment of the German project:—

"The International Telegraph Conference of Buda-Pesth very much appreciate the importance of the German proposition to simplify rates and accounts in the European system.

"They are convinced that a simplification of rates and accounts is desirable in the European system, and are of the opinion that at present there are serious financial objections which hinder the acceptance, pure and simple, of the propositions put forward by Germany and the Bureau International of Berne. For this reason it is necessary to defer any decision on the subject until the next conference."

In accordance with Article 10 of the Convention, the franc is the monetary unit which enters into the composition of international tariffs. To facilitate this, the regulation fixes the rate of exchange for countries which do not have the franc as a monetary unit.

The equivalents as fixed by the Paris regulations have undergone several modifications at Buda Pesth.

It has been admitted that administrations have the power to make modifications in equivalents during the interval between two conferences, at all times when the value of the money changes or varies considerably, owing to fluctuations in rates of exchange.

In according this privilege, the Conference has determined the manner in which the modifications of equivalents are to be made. Administrations have to inform other offices of modifications through the Bureau International, and have also to give the date upon which they are to be put into force. (New Paragraph 5 of Article 28.)

(To be continued.)

A MODERN WAREHOUSE INSTALLATION.

An electric installation embodying the most modern practice, together with several novel features in detail, has just been completed in the extensive new warehouse of Messrs. Marshall & Aston, Lever Street, Manchester.

The work has been executed by Messrs. Geo. Hill & Co., of Old Trafford, to the specification and under the supervision of Mr. H. C. Crews, consulting engineer, Manchester. The installation consists of some 70 arc lamps, 100 glow lamps, gas engine, dynamo and main switchboard for both private plant and the Corporation five-wire connections. The whole of the wiring is carried out on the interior conduit system, in insulated iron tubes run between floors, &c., with junction boxes at all bends, so that although it is difficult to see a pipe anywhere, still small traps in floor-boards, which are branded in order to be easily found, can be raised, and the wiring anywhere drawn in or out for repairs, renewals, or enlargements of wires if required.

Arc lighting for the general illumination of the various floors has been adopted as being the most economical in working, and also particularly suitable for many of the departments dealing with large stocks of coloured material, the arc lamp being now well known as the most reliable artificial light for colour work.

All arc lamps are of the latest Brockie-Pell type, burning with a current of 7 amperes, two in series, for 12 hours with ordinary carbons. As a maximum height of only 11 feet could be obtained between floors, the lamps were made specially short, and the top part is carried up between ceiling joists in a fireproof iron casing completely surrounding the lamp, into which circuit pipes are carried and nutted up both inside and out. Another foot in height is thus gained, all unsightly connecting or supporting wires are hidden, and a finish is given to the lamps at ceiling level by a separate spinning of somewhat same design to lamp corona. The lamps are fixed from above, and, as in the case of junction boxes, a branded trap in floor-boards above gives free access to the terminals and suspending arrangements.

The arc lamps have not been fixed in straight lines, as is often done, but, generally speaking, they are alternated, their exact position having been arrived at by describing circles of effective lighting area on the plans, and arranging such circles to cover the various floors as near as possible; the effect of this is very satisfactory, a most uniform light being obtained everywhere.

Specially insulated twin wires are run back to the engine room for every pair of lamps without any local switches, it being considered that for economical working and steady running of plant, only one person should have control of the switching arrangements. Every

pair of lamps has its switch and double-pole fuses in the engine room, each switch is numbered, a corresponding number being painted on the lamp globes, and as there is a telephone system by which the engineer can be easily communicated with from any floor, the heads of the various departments can have their lamps switched on or off in pairs as required.

Incandescent lighting is at present only used in the counting house, small offices, lift doors, &c., for which special wrought-iron and copper fittings have been designed, and all wirings carried out on the sub-circuit distribution system in small circuits from double-pole fuse-boards and local switches.

To provide for any extra glow lamps, a pair of mains have been run up two of the lifts in different parts of the building, and on each floor a small double-pole fuse-board is fixed at ceiling level, so that lights can be run from any point and connected to the double-pole fuses on nearest pair of mains. A Stockport gas engine of 50 brake horse-power, by Messrs. Andrews, of Reddish, is fixed in engine room, and has two fly-wheels, each of 2½ tons weight. It is fitted with self-starter, special adjustable governor, and all the latest improvements. The ignition tube is controlled by a ½-inch Stott mercury governor, so that however the town supply pressure varies, an ignition flame of constant dimensions is obtained without further regulation. Cooling water for cylinder has been arranged for in two wrought-iron tanks of ample area, specially shaped to fit into corners of engine room and allow a working space round the engine, there being no other suitable position for them, and no provision having been made originally for an electric plant, the basement space available for engine room is very limited. There is an overflow pipe in the hot tank and exhaust pipes from hydraulic hoists are constantly discharging cool water into the other tank, so that temperature of water is always kept low. An extra water supply from town low pressure mains is also provided in case hoists may be stopped for repairs for any length of time. The dynamo by the Electric Construction Company, Wolverhampton, running at a speed of 450 revolutions, is capable of giving 30 kilowatts at 100 volts, and being slightly over-compounded, makes up for the various small losses at full load. An extra bearing, heavy fly-wheel, and fast and loose pulleys are provided, so that gas engine starts without weight of dynamo armature and fly-wheel, the 5 tons of engine fly-wheel being quite enough load for effective working of the self-starter. A belt-tightening device, worked by one large hand wheel, well away from the belt, acts simultaneously on base of dynamo at three separate points, and moves machine along parallel to its last position, so that after once setting, the belt runs truly in centre of pulley whatever be the position of dynamo on slide rails.

The main switchboard by Messrs. Dorman and Smith, of Salford, is complete with main ammeter and voltmeter, main double-pole dynamo switch and fuses, main five-pole corporation switch, two incandescent circuit switches, and eight changeover switches, &c. Two of the latter throw the glow lamps either on to two different corporation circuits or on to private plant; the other six changeover switches put arc lamps on various floors either across different pairs of the corporation mains or on to the plant, so that even at full load the lighting can, if necessary, be transferred with only a flicker from one source of supply to the other in sections, without any undue strain on either supply; or both sources of current may feed different circuits at the same time. The latter case will be particularly useful if future lighting extensions overload the private plant.

The arc lamp distribution boards on separate slate bases are fixed at the side of main switchboard with a low reading ammeter above, and there is a simple arrangement on each circuit consisting of an extension on one pair of poles of the spring-clip fuses, into which the ammeter plug can be inserted, then by drawing one fuse out of its clips, the current goes through ammeter without breaking the circuit, and thus it can be noted that the lamps are burning with their proper current.

An 18-inch "Cyclone" electric fan is fixed in engine room for ventilation, and also to prevent any smell from engine rising into warehouse. With regard to cost of working, this has been gone into carefully, and it is estimated that an average full load for 2 hours per day will be required, equal to 500 hours (full load) per annum, and the approximate estimated cost of same will be as follows:—

PRIVATE PLANT. Total Estimated Annual Cost with Private Plant.		CORPORATION MAINS. Total Estimated Annual Cost from Corporation Supply.	
Gas for engine (2s. 3d. per 1,000)	£55	Current at 6d. per unit ...	£375
Interest, 4 per cent. on £2,000	80	Interest, 4 per cent. on £1,300	52
Depreciation, 5 per cent. on £1,300 (still plant) ...	65	Depreciation, 5 per cent. on £1,300	65
Depreciation, 10 per cent. on £700 (moving plant) ...	70		
Wages	90	Wages	80
Carbons	35	Carbons	35
Repairs, oil, sundries, &c. ...	25	Repairs and sundries ...	13
	£420		£620

It will thus be seen that the private plant will effect an estimated saving of approximately £200 per annum over the Corporation supply, which would be at the rate of 6d. per unit, as the short hours of lighting would not effect a saving on the alternative fixed charge method of payment for current. The above figures are only approximate estimates, but as a suitable meter has been inserted in dynamo circuit, we hope, after a year's working, to be able to publish actual figures.

It is interesting to note that the *same amount of light* produced by means of ordinary gas burners would cost at least £700 per annum, and this, together with interest and depreciation, repairs, &c., would reach £800.

NEW PATENTS.

[*Compiled expressly for this journal by* W. P. Thompson & Co., *Electrical Patent Agents*, 322, *High Holborn, London, W.C., to whom all inquiries should be addressed.*]

22,000. "Improvements in arc lamps employed in electric lighting." J. H. Wheat and A. Wheat. Dated October 5th.

22,043. "Improved means applicable for use in working electric railways provided with underground conductors." A. Hecker. Dated October 5th.

22,046. "Improvements in electric switches." R. E. B. Crompton and E. A. N. Pochin. Dated October 5th.

22,061. "Converting direct electric currents into alternating currents." D. Cook. Dated October 5th.

22,069. "Improvements in electric accumulators or storage batteries." D. Young. (La Société Anonyme Accumulateur Eclair, Belgium.) Dated October 5th.

22,076. "Electric current director system for saving telephone and telegraph lines." J. S. E. Ellis. Dated October 5th. (*Complete.*)

22,093. "Improvements in and connected with dynamos or electric generators more especially to small machines where permanent magnets are used." J. H. Ward and M. H. Goldstone. Dated October 6th.

22,102. "An electric lighting device for oil lamps." H. D. Fitzpatrick. (J. Eckel and A. Glinicke, Germany.) Dated October 6th. (*Complete.*)

22,127. "Improvements in electric locomotives." H. H. Lake. (L. Warfield, United States.) Dated October 5th.

22,129. "Improvements in methods or processes for electro-thermally treating materials for the manufacture of calcium carbide and the reduction of metals from their oxides or other compounds." H. Maxim. Dated October 6th.

22,144. "Improvements in electric or other motor trucks." The British Thomson-Houston Company, Limited. (N. C. Bassett, United States.) Dated October 6th. (*Complete.*)

22,146. "Improvements relating to electric light and power circuits." E. W. Bowles. Dated October 6th.

22,156. "A new or improved duplex electric switch." P. F. W. Simon. (F. W. Busch, Germany.) Dated October 6th.

22,167. "Improvements in or connected with electric incandescent lamps." C. Boudewijnse. Dated October 6th.

22,173. "Improvements in or relating to telephonic apparatus." P. J. Bose. Dated October 6th. (*Complete.*)

22,194. "A process for carbonisation of peat by electric heating." P. Jebsen. (Date applied for under Patents, &c., Act, 1883, Section 103, March 13th, 1896, being date of application in Norway.) Dated October 6th.

22,226. "An improved automatic electrical cut-out." H. J. Wagg. Dated October 7th.

22,269. "An improvement in telephone switches (automatic)." W. Wyld. Dated October 8th.

22,282. "Improvements in ceiling roses for electric lamps." C. T. Briscoe, and G. H. Shaw. Dated October 8th.

22,326. "Improvements in electric apparatus for lighting and extinguishing gas jets." G. F. Krieger. Dated October 8th.

22,333. "A method of exciting synchronous or asynchronous dynamo-electric machines or motors working with alternating currents of constant potential." J. Imray. (La Société Anonyme pour la transmission de la force par l'electricité, France.) Dated October 8th.

22,352. "Improvements in electric cables." H. Edmunds. Dated October 8th.

22,353. "Improvements in apparatus for completing interrupting, diverting, and controlling electric currents." H. Edmunds. Dated October 8th.

22,360. "An improved automatic telephonic exchange system." S. Berditschewsky-Apostoloff. Dated October 8th.

22,402. "Improvements in switches for electric currents." W. R. Rawlings and J. J. Rawlings. Dated October 9th. (*Complete.*)

22,416. "Improvements in and relating to the supports or holders of electric incandescent lamps." E. Prentice. Dated October 9th.

22,423. "An improved manufacture of electrodes for secondary voltaic batteries." L. Epstein. Dated October 9th.

22,442. "Improved means for electrically heating water and other liquids." R. E. Loesener. Dated October 9th.

22,464. "Improvements in electric switches." J. Marsden and M. Pearson. Dated October 10th.

22,465. "Improvements in electric measuring instruments." A. Wright. Dated October 10th.

22,476. "The rotary life guard suitable for tram cars, electric cars, cable cars, auto and motor cars, and locomotives (shunting engines) and other self-propelled vehicles." J. Daniel and W. F. Stanley. Dated October 10th.

22,513. "An improvement in telegraph cables and their connections." J. M. Barr and C. E. S. Phillips. Dated October 10th.

22,530. "Improved means for controlling and for effecting combinations in the stops of electro-pneumatic organs." A. G. Hill. Dated October 10th.

22,552. "Improvements in apparatus for electrically actuating the stopping mechanism of engines, motive power, or machinery in cases of accident or otherwise, in part applicable to other purposes." G. E. M. Stone. Dated October 10th.